

PREPARED FOR THE CITIZENS OF COLORADO AND ITS VISITORS
BY COLORADO PARKS AND WILDLIFE

State Wildlife Action Plan



A STRATEGY FOR CONSERVING WILDLIFE IN COLORADO



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Foreword

United States laws and policies place primary responsibility for wildlife management in the hands of the states. The states have a lengthy record of success in conserving species, including those that are hunted or fished and those that are not. In Colorado, these successes have been paid for by a variety of sources, including lottery proceeds distributed by Great Outdoors Colorado, the Species Conservation Trust Fund, and federal dollars. Development of partnerships has added to the efficiency of conservation success. It is no surprise that the task of conserving **all** species will take more than traditional funding sources and single agency action.

The State Wildlife Grants program (*Title IX, Public Law 106-553 and Title 1, Public Law 107-63*), created through federal legislation, is meant to help close the funding gap by providing federal aid to states to secure the status of Species of Greatest Conservation Need. This State Wildlife Action Plan (SWAP) has been prepared in fulfillment of the requirements of that legislation.

Beyond those requirements is a more fundamental goal for this strategy, held by Colorado Parks and Wildlife and the state as a whole: to secure wildlife populations so that they do not require protection via federal or state listing regulations. This requires collaboration among a diverse set of agencies, interests, and citizens. CPW's Species Conservation Program works in conjunction with our stakeholders, using the best available science to conserve Colorado's at-risk species and habitats. The SWAP is the roadmap for this collaboration.

Colorado's revised SWAP serves as a blueprint for conservation and provides a catalog on the status of our knowledge about native wildlife and plants (most of which are not commonly hunted or fished), threats to the habitats upon which they depend, and strategies to lessen, mitigate, or manage those threats. Thus, **Colorado's SWAP is comprehensive in scope and strategic in nature**. This SWAP reflects the data that currently exist for Colorado species and their habitats and the collective judgment of many of Colorado's scientists, as well as the interests and concerns of citizens with a stake in Colorado wildlife conservation.

Again, implementation of this plan is beyond the scope of a single agency. The issues addressed and the actions outlined in this plan cross political, jurisdictional, and ecological boundaries. Commitment, coordination and communication among the diverse and interested parties involved are critical to the collaborative success that the SWAP describes and aims to achieve. Developing the plan to achieve those goals is the first step, and this has been accomplished. Implementation is the next step and we look forward to this important and collaborative effort.

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Chapter 1: Introduction

Purpose of the SWAP

Historically, all fish and wildlife conservation in Colorado, and in the nation, was funded largely by sportsmen and women. Recently, funding for conservation of non-hunted species has been undertaken using non-traditional sources of funding to establish a reliable base. This funding comes from sources such as lottery proceeds distributed by Great Outdoors Colorado, the Species Conservation Trust Fund, federal aid dollars, and other sources. Species identified as federally threatened or endangered under the Endangered Species Act receive additional attention, but not necessarily adequate funding.

Recognizing that there has not been enough revenue at a national level available for conservation of all wildlife species, leaders in the conservation community sought to provide a new source of funding. Teaming with Wildlife, a diverse national coalition of conservationists, hunters, anglers, and conservation-minded agencies, organizations, and businesses lobbied for passage of the necessary national legislation for this new source of funding. The Commerce, Justice and State Appropriations Act of Fiscal Year 2001, Title IX, Public Law 106-553 created the Wildlife Conservation and Restoration Program (WCRP), designed to provide funding for the conservation needs of wildlife, as well as for education and wildlife-related recreation. The WCRP was only funded for one year. A second act, the Department of the Interior and Related Agencies Appropriations Act of 2002, Public Law 107-63, Title 1, created a State Wildlife Grants program (SWG), which provides annual funding for conservation of wildlife and wildlife habitats. The SWG requires that each state prepare and adopt a State Wildlife Action Plan (SWAP) to remain eligible for SWG funding. This SWAP meets Colorado's obligation under this law.

Philosophy and Guiding Principles

Although development of Colorado's SWAP was coordinated by Colorado Parks and Wildlife (CPW), it is not simply a plan for that agency. Rather, it is a plan for all of Colorado. The task of conserving and managing Colorado's wildlife is too big for any one group or agency to achieve alone. This document identifies conservation priorities that can be used by everyone in Colorado as a guide for planning, partnership building, and project design.

The SWAP articulates a set of conservation priorities that considers an expansive array of wildlife from a statewide perspective. The purpose of this SWAP is to foster greater coordination between the conservation actions of CPW and other members of Colorado's wildlife

conservation community, thus enabling all partners to collectively meet the state's wildlife conservation needs. As such, this SWAP is designed to complement the substantial planning and active management programs that already exist in Colorado, and to support cooperation with adjacent states when such cooperation will result in range-wide conservation of species of greatest conservation need.

Colorado's SWAP is not a legal document, a regulatory document, a Recovery Plan under the Endangered Species Act (ESA), or a National Environmental Policy Act (NEPA) decision document. All parties should consider this guidance, along with other information, as they follow established public participation protocols and legal requirements when preparing decision documents and project proposals.

The guiding principles of this strategy are to:

1. Encourage and support conservation actions that meet the needs of Species of Greatest Conservation Need;
2. Manage for healthy habitats and ecosystems so that all species will benefit;
3. Create a strategy that will be flexible enough to incorporate new research findings and successful management innovations into conservation actions;
4. Acknowledge the pivotal role that private landowners and local stakeholders play in conservation;
5. Enhance, not replace, other planning efforts; and
6. Maintain an atmosphere of cooperation, participation, and commitment among wildlife managers, landowners, private and public land managers, and other stakeholders in development and implementation of conservation actions.

Federal SWAP Requirements: The Eight Elements

Colorado's SWAP meets the requirements of guiding federal legislation. It is based on the best available information and identifies data gaps where they exist. It is, and will continue to be, the result of involving virtually all of Colorado's conservation agencies, organizations, and affected stakeholders.

The enabling legislation and regulations governing the SWG and related programs stipulate that a state's SWAP contain the following eight elements (referred to throughout the SWAP as "Element 1, Element 2, and so on):

1. **Information on the distribution and abundance of species of wildlife**, including low population and declining species that are indicative of the diversity and health of the state's wildlife;

2. Descriptions of **locations and relative condition of key habitats** and community types essential to conservation of species identified in (1);
3. **Descriptions of issues** that may adversely affect species identified in (1) or their habitats, **and priority research and survey efforts needed** to identify factors which may assist in restoration and improved conservation of these species and habitats;
4. Descriptions of **conservation actions** proposed to conserve the identified species and habitats and **priorities for implementing such actions**;
5. Proposed **strategies for monitoring species** identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions;
6. Descriptions of **procedures to review** the Wildlife Action Plan at intervals not to exceed 10 years;
7. Strategies for **coordinating** the development, implementation, review, and revision of the Wildlife Action Plan with federal, state, and local agencies and Native American tribes that manage significant land and water areas within Colorado or administer programs that significantly affect the conservation of identified species and habitats; and
8. Provisions to ensure **public participation** in the development, revision, and implementation of the Wildlife Action Plan, and associated projects and programs.

Roadmap to the Eight Required Elements

The SWAP addresses the eight required elements using both species and habitat approaches. Table 1 lists the locations within the SWAP where information pertaining to each of the eight required elements may be found. Tables 7 and 8 identify cross-relationships between species and their habitats. Information pertaining to plants and invertebrate animals (with the exception of mollusks) can be found in Appendices A and B, respectively.

Table 1. Locations of Required Elements in the SWAP.

Required Element	Location(s)
1 – Distribution and abundance of wildlife species	
a. sources of information	Chapter 2
b. abundance and distribution	Chapter 2; Table 7
c. low and declining populations	Chapter 2; Tables 3 & 7
d. consideration of all major wildlife groups	Chapter 2; Appendices A & B
e. process for selecting SGCNs	Chapter 2; Table 2
2 – Locations and conditions of key habitats	
a. level of detail	Chapter 3
b. location, relative condition, and conservation actions needed	Chapter 3, Table 8; Chapter 8, Figures 17 - 19
3 – Problems that may adversely affect species and habitats	
a. sources of information	Chapters 1, 5, and 6
b. detailed threats	Chapter 4; Chapter 5, Table 7; Chapter 6, Table 8; Appendix F
c. threats relevant to species and habitats	Chapter 5, Table 7; Chapter 6, Table 8; Appendix F
d. research and survey efforts needed	Chapter 5, Table 7; Chapter 6, Table 8
4 – Conservation actions that may conserve species and habitats, and priorities for implementing actions	
a. how conservation actions address threats	Chapter 4; Chapter 5, Table 7; Chapter 6, Table 8
b. descriptions of conservation actions	Chapter 4; Appendix D
c. linking actions to objectives and indicators	Chapter 5, Table 7; Chapter 6, Table 8
d. actions for partners	Chapter 5, Table 7; Chapter 6, Table 8
e. research and survey efforts needed	Chapter 5, Table 7; Chapter 6, Table 8
5 – Proposed plans for monitoring species and habitats	
a. plans for monitoring SGCN and habitats	Chapter 7; Appendices A & B
b. monitoring outcomes of conservation actions	Chapter 7; Appendices A & B
c. species not monitored	Chapter 7; Appendices A & B
d. monitoring at multiple levels	Chapter 7; Appendices A, B, & G
e. relationship to existing monitoring/survey systems and determining effectiveness of conservation actions	Chapter 7; Appendices A, B, & G
f. geographic scale	Chapter 7; Appendices A, B, & G
g. adaptive management	Chapter 7; Appendices A, B, & G
6 – Procedures to review the SWAP	
a. review process	Chapter 9
7 – Coordination with other land management agencies	
a. involvement of federal, state, and local agencies and Indian tribes in development of SWAP	Chapter 9; Appendices H & I
b. continued involvement of agencies and tribes in implementation, review, and revision	Chapter 9
8 – Public participation	
a. public involvement in development of SWAP	Chapter 1; Chapter 9; Appendices H & I
b. continued public involvement in implementation and revision	Chapter 9

SWAP Development Process

Maximizing the quality, effectiveness, and efficiency of stakeholder participation was a primary consideration in establishing the methods used to prepare Colorado's 2015 SWAP. To this end, CPW created an online participation platform consisting of a web page¹ and a dedicated email. The process for revising each of the required elements with scientific content (the first five elements) in Colorado's 2006 SWAP involved the following steps:

1. Review of 2006 SWAP content by CPW and Colorado Natural Heritage Program (CNHP) biologists, and drafting of proposed revisions based on the most current information available;
2. Stakeholder review of draft revised chapter using dedicated online resources (webpage and email);
3. Final draft chapter prepared;
4. All stakeholder comments compiled along with CPW responses; and
5. All materials posted on CPW's SWAP webpage for public access.

Over 100 CPW staff were involved in the revision process, including Species Conservation Coordinators, Habitat Coordinators, GIS analysts, CPW Terrestrial and Aquatic biologists, and regional staff and representatives from CPW's Research, Real Estate, and Leadership Teams. Please refer to Chapter 9 of this document for a more detailed description of the agency coordination and the public participation process.

Management and Legal Authorities

A diversity of state, federal, and county regulations offer protection to Colorado's species of greatest conservation need, and there are many management programs that support population and habitat conservation actions. More broadly, there is a diversity of entities that directly or indirectly manage or affect wildlife through their actions. The job of coordinating this diversity of managers is an important institutional determinant of success for Colorado's SWAP. That job falls to CPW. The following statutory authorities and policies provide necessary guidance for CPW in its role as the state's SWAP coordinator.

Colorado Parks and Wildlife, a branch of the Colorado Department of Natural Resources, has the statutory charge for managing and conserving wildlife resources within state borders, for hunted, fished, and non-game wildlife, including state-listed threatened and endangered species². The

¹ <http://cpw.state.co.us/aboutus/Pages/StateWildlifeActionPlan.aspx>

² Colorado Revised Statutes, Title 33 Article 1-101 states: "It is the policy of the state of Colorado that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors. It is further declared to be the policy of this state that there shall be provided a comprehensive program designed to offer the greatest possible variety of wildlife-related recreational

U.S. Fish and Wildlife Service (USFWS) has management for the species that are protected under the federal Endangered Species Act.

The Colorado Parks and Wildlife Commission is embarking on a strategic planning process to guide CPW's efforts into the future. This new strategic plan will set a high level vision, overarching goals, and strategies for Colorado's state parks, wildlife and outdoor recreation resources. Following completion of the Commission's 2015 Strategic Plan, CPW will develop finer scale implementation plans to outline how agency goals will be achieved. The SWAP will help to guide the implementation of plans to achieve conservation goals for Colorado's Species of Greatest Conservation Need.

Overview of Colorado Wildlife Species

Colorado's native species occur across our state's 103,000 square miles, including 480 square miles of waters. There are over 960 native species for which CPW has statutory authority, including mammals, birds, fish, reptiles, amphibians, mollusks, and crustaceans. Colorado is also home to many hundreds of plant and invertebrate animal species that fall outside of CPW's authority. Colorado manages wildlife at the species, subspecies, and population level, depending on various factors such as legal requirements, interagency coordination needs, stakeholder concerns, funding eligibility, national or international reporting conventions, and/or taxonomic determinations through scientific documentation. Colorado also manages assemblages of species and the array of habitats important to them (i.e., ecosystem management).

opportunity to the people of this state and its visitors and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities." Title 33 Article 2-102 states, "The general assembly finds and declares that it is the policy of this state to manage all nongame wildlife, recognizing the private property rights of individual property owners, for human enjoyment and welfare, for scientific purposes, and to insure their perpetuation as members of ecosystems; that species or subspecies of wildlife indigenous to this state which may be found to be endangered or threatened within the state should be accorded protection in order to maintain and enhance their numbers to the extent possible; that this state should assist in the protection of species or subspecies of wildlife which are deemed to be endangered or threatened elsewhere; and that adequate funding be made available to the division annually by appropriations from the general fund."

Chapter 2: Species of Greatest Conservation Need

This chapter presents updated information on wildlife species that are in need of conservation attention in Colorado, with a focus on native species. Colorado's first SWAP, completed in 2006, identified 210 Species of Greatest Conservation Need (SGCN). Those species were grouped into Tier 1 and Tier 2 categories, reflecting a relative degree of conservation priority. Conservation attention is still warranted for the species on the original SGCN list. However, the utility of such a long Tier 1 species list for prioritizing conservation work over the intervening years has been somewhat confounding. Thus, a primary focus of the SGCN component in this SWAP revision has been to improve the SWAP's usefulness for conservation prioritization, while continuing to recognize the broader interests and capacity of Colorado's conservation community overall. To that end, we have re-defined how we are characterizing Tier 1 and Tier 2 SGCN, and modified the criteria used to determine Tier 1 and Tier 2 status.

Also, in the interest of improving the SWAP's applicability across Colorado's conservation community, we have added a rare plant component to the plan, and retained and expanded the insect component of the SGCN list. Though CPW does not have statutory authority over plant and insect species, we recognize the crucial role these taxa play in the ecosystems and wildlife communities of the State. SWAP elements for plants and non-mollusk invertebrates are presented in Appendices A and B, respectively.

Revised Interpretation of Tier 1 and Tier 2

Although the 2015 revision of Colorado's SWAP retains the original two-tier SGCN structure, **we have re-interpreted the Tier 1 list to represent the species which are truly of highest conservation priority in the state**, and to which CPW will likely focus resources over the life of this plan. Though the agency will certainly maintain flexibility in responding to evolving conservation needs and scientific knowledge, our best current estimate of how our work will probably be focused over the coming decade is reflected in the new Tier 1 list of 55 species. All other previously Tier 1 SGCN have been moved to the Tier 2 list, with one exception. Recent genetic studies indicate that the subspecies designation for northern pocket gopher (*Thomomys talpoides macrotis*) is not valid. Thus, this subspecies has been removed from the SGCN list. Tier 2 species remain important in light of forestalling population trends or habitat conditions that may lead to a threatened or endangered listing status, but the urgency of such action has been judged to be less. When planning future conservation work, these tier rankings should be considered along with other important factors, including potential funding and partnership

opportunities, and responsiveness to “one-time-only” opportunities. It is our hope and expectation that our conservation partners and stakeholders will work together toward conservation of all SGCN, including those on the Tier 2 list. As an agency, we remain committed to improving the status of all SGCN, and welcome collaborative efforts to do so.

Revised SGCN Criteria

For this iteration of our SWAP, we have expanded the criteria that were used to develop the original SGCN list³, which were primarily focused on species' conservation status. Those criteria were retained and augmented by further consideration of the species' role in Colorado wildlife communities, as well as our ability to make a measurable contribution to conservation of species populations, according to the criteria listed in Table 2. In distinguishing Tier 1 and Tier 2 species in the original SWAP, we developed an additional set of sub-criteria that placed more emphasis on economic considerations⁴. Due to the revised interpretation of Tier 1 status, some of these criteria were deemed to be of less importance in the revised SWAP. The remaining criteria have been absorbed into the updated criteria in Table 2.

³ Listed as federal candidate, threatened or endangered species under the ESA; Classified as state endangered or threatened species, or species of special concern; Global ranking scores of G1, G2 or G3 by the Colorado Natural Heritage Program; Identified as conservation priorities through a range-wide status assessment or assessment of large taxonomic divisions; Assigned state ranking scores of S1 or S2 AND a global ranking score of G4 by the Colorado Natural Heritage Program. Species were removed from the list if they: occur peripherally in Colorado but are common elsewhere AND for which management actions in Colorado are likely to have no population-level effect; are very common but were placed on lists due to economic considerations (e.g., Mallard).

⁴ Knowledge of management techniques needed for recovery; Impact on federal recovery; Cost of recovery or management action implementation; Direct cost of recovery action to others; Public appeal or interest in the species; Economic impacts of listing (cost incurred by listing); Importance to state biological diversity; Multiple species benefits from management of target species.

Table 2. Criteria used to revise the list of Tier 1 Species of Greatest Conservation Need.

1) Federal and State Status
a) Listed or proposed as endangered at federal or state level
b) Listed or proposed as threatened at federal or state level
c) Other indication of special concern at federal or state level
2) Colorado's contribution to the species overall conservation (portion of overall range that occurs in Colorado)
a) The health of the population in Colorado compared to other portions of its range (better = higher)
b) Population status and level of conservation activity in surrounding states and other portions of the species range
c) Level of conservation activity in Colorado relative to its status in the state
3) Urgency of conservation action:
a) New threats to the species
b) Lack of Scientific Knowledge
c) Increases in severity of existing threats or new data that show a significant, persistent decline in population status
d) Likelihood and immediacy of potential ESA listing
e) Funding or partnership opportunities that are time limited
4) Ability to Implement Effective Conservation Actions:
a) Few regulatory issues present to impede conservation success
b) Limitations in mitigating population and/or habitat threats are minimal (i.e., conservation success is highly likely)
c) Cost to implement effective conservation
d) Socio-political factors (general willingness to support conservation of the species)
5) Ecological Value of the species:
a) Species is a good indicator to the overall health of the habitat it occupies
b) Keystone species – plays a significant role in defining the habitat in which it lives
c) Umbrella species – protecting these species indirectly protects the many other species that make up the ecological community used by the species

Updated SGCN List

The 2015 SGCN list of vertebrate animals and mollusks– the groups for which CPW has statutory authority – contains 159 species (Table 3). Fifty-five species have been identified as Tier 1 SGCN, including 2 amphibians, 13 birds, 25 fish, 13 mammals, and 2 reptiles (Table 3). Of these, all were on the Tier 1 SGCN list in 2006 with the following exceptions: White-tailed ptarmigan⁵ and wolverine were previously Tier 2; plains topminnow, little brown bat, New Mexico meadow jumping mouse, and American pika were not SGCN in 2006. Conservation opportunity, Colorado's contribution to conservation, and changes in conservation status are all partially explanatory in these changes.

⁵ The 2006 SWAP listed white-tailed ptarmigan as a SGCN at the species level. This 2015 SWAP lists the subspecies Southern white-tailed ptarmigan, based on the USFWS recognition of the Colorado population of white-tailed ptarmigan as a separate subspecies.

The revised Tier 2 SGCN list of vertebrates and mollusks contains 104 species, including 8 amphibians, 48 birds, 2 fish, 23 mammals, 14 reptiles, and 9 mollusks. Of the Tier 2 species, 10 vertebrates and one mollusk were not identified as SGCN in 2006. The pygmy rabbit was not a SGCN in 2006 because at that time the species had not been reported in Colorado. Recent evidence suggests that this species may be present in northwestern Colorado. The following species were not SGCN in 2006, but have been added to the 2015 Tier 2 list due to designation as a Sensitive Species by the Bureau of Land Management and/or the U.S. Forest Service: Great Basin spadefoot, black tern, grasshopper sparrow, Rocky Mountain capshell, American marten, big free-tailed bat, hoary bat, pygmy shrew, desert spiny lizard, and milksnake. Thirty bird species have been removed from the SGCN list. This change is not a result of change in species status, but rather is due to the revisions of the criteria used to define SGCN.

There are four species on the SGCN list that no longer occur as wild populations in Colorado: bison, gray wolf, grizzly bear, and wolverine. These species were historically part of Colorado's native animal community, and would meet the criteria for SGCN if they were to re-colonize or be re-introduced to the state during the time period covered by this plan. There are no plans to re-introduce wolves or grizzly bears to the state, but it is possible that wolverine and/or genetically pure, wild bison could be re-introduced if social and political concerns can be satisfactorily addressed and such efforts are biologically justified.

Status and Trend

The status of each vertebrate and mollusk SGCN is summarized in Table 3. The lists generated by the U.S. Fish and Wildlife Service, U.S. Forest Service, Bureau of Land Management, State of Colorado, Colorado Natural Heritage Program, and NatureServe all use species status in some form to develop their respective lists. We did not develop a new metric that specifically evaluated species status within Colorado, but rather used the lists generated by these other organizations to inform our evaluation of species status.

A species' population trend is also used by other organizations in the development of their lists, but we do consider it as a separate factor here (Table 3, Declining Trend column). Both data from studies as well as best professional judgments were used to determine declining trend. Data were found in recovery plans, status assessments, and both published and unpublished reports. For landbirds we relied heavily upon the Partners in Flight Species Assessment Database (PIF Science Committee 2012) to evaluate trends on a continental scale.

Table 3. Vertebrate and Mollusk Species of Greatest Conservation Need.

Species are grouped by Tier and taxonomic group, and then sorted alphabetically by common name. Legend: Federal Listing: LE – listed Endangered; LT – listed Threatened; LT* - listed Threatened status applies to Distinct Population Segment only; C – Candidate; P – Petitioned; N - Not Warranted. State Listing: SE – state endangered; ST – state threatened; SC – Special Concern. Agency Sensitive: BLM – Bureau of Land Management; USFS – U.S. Forest Service; USFWS – U.S. Fish and Wildlife Service Birds of Conservation Concern for Bird Conservation Regions 16 and 18. NatureServe Global/State Status: 1 – critically imperiled; 2 – imperiled; 3 – vulnerable; 4 – apparently secure, but with cause for long-term concern; 5 – demonstrably secure; T – subspecies status; Q – taxonomic uncertainty; B – breeding; N – non-breeding; NR – not ranked; X - extirpated. Species mark with a double-asterisk (**) were added as habitat indicator species.

Species	Common Name	Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CO's Contribution to Conservation	Urgency of Conservation Action	Ability to Implement Effective Conservation Actions	Ecological Value of the Species	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
AMPHIBIANS															
<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain population)	Tier 1	P	SE	x	x			x	x		x	G4T1	S1	
<i>Lithobates pipiens</i>	Northern leopard frog	Tier 1		SC	x	x						x	G5	S3	?
BIRDS															
<i>Leucosticte australis</i>	Brown-capped rosy-finch	Tier 1					x	x				x	G4	S3B,S4N	
<i>Athene cucularia</i>	Burrowing owl	Tier 1		ST	x	x	x					x	G4	S4B	
<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	Tier 1		SC	x	x				x	x	x	G4T3	S2	
<i>Aquila chrysaetos</i>	Golden eagle	Tier 1					x			x		x	G5	S3S4B, S4N	
<i>Centrocercus urophasianus</i>	Greater sage-grouse	Tier 1	C	SC	x	x		x		x	x	x	G3G4	S4	
<i>Grus canadensis tabida</i>	Greater sandhill crane	Tier 1		SC									G5T4	S2B,S4N	x
<i>Centrocercus minimus</i>	Gunnison sage-grouse	Tier 1	LT	SC		x	x	x	x	x	x	x	G1	S1	
<i>Tympanuchus pallidicinctus</i>	Lesser prairie-chicken	Tier 1	LT	ST		x	x	x			x	x	G3	S2	

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<i>Charadrius montanus</i>	Mountain plover	Tier 1		SC	x	x	x						G3	S2B	
<i>Tympanuchus phasianellus jamesii</i>	Plains sharp-tailed grouse	Tier 1		SE									G4T4	S1	
<i>Lagopus leucura altipetens</i>	Southern white-tailed ptarmigan	Tier 1	P		x							x	G5	S4	
<i>Empidonax traillii extimus</i>	Southwestern willow flycatcher	Tier 1	LE	SE			x						G5T1T2	SNA	
<i>Coccyzus americanus occidentalis</i>	Western yellow-billed cuckoo	Tier 1	LT*	SC	x	x	x			x			G5T3Q	S1B	
FISH															
<i>Etheostoma cragini</i>	Arkansas darter	Tier 1	C	ST		x							G3G4	S2	
<i>Catostomus discobolus</i>	Bluehead sucker	Tier 1			x	x			x	x		x	G4	S4	
<i>Gila elegans</i>	Bonytail chub	Tier 1	LE	SE					x	x			G1	SX	
<i>Hybognathus hankinsoni</i>	Brassy minnow	Tier 1		ST								x	G5	S3	
<i>Ptychocheilus lucius</i>	Colorado pikeminnow	Tier 1	LE	ST					x	x		x	G1	S1	x
<i>Oncorhynchus clarkii pleuriticus</i>	Colorado River cutthroat trout	Tier 1		SC	x	x						x	G4T3	S3	
<i>Luxilus cornutus</i>	Common shiner	Tier 1		ST									G5	S2	
<i>Catostomus latipinnis</i>	Flannelmouth sucker	Tier 1			x	x			x	x		x	G3G4	S3	
<i>Platygobio gracilus</i>	Flathead chub	Tier 1		SC	x								G5	S3	
<i>Oncorhynchus clarkii stomias</i>	Greenback cutthroat trout	Tier 1	LT	ST					x			x	G4T2T3	S2	
<i>Gila cypha</i>	Humpback chub	Tier 1	LE	ST						x			G1	S1	x
<i>Catostomus playtrhynchus</i>	Mountain sucker	Tier 1		SC	x	x							G5	S2	
<i>Phoxinus eos</i>	Northern redbelly dace	Tier 1		SE	x						x		G5	S1	
<i>Lepomis humilis</i>	Orangespotted sunfish	Tier 1									x		G5	S5	x

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<i>Etheostoma spectabile</i>	Orangethroat darter	Tier 1		SC									G5	S3	x
<i>Hybognathus placitus</i>	Plains minnow	Tier 1		SE	x							x	G4	SH	
<i>Fundulus sciadicus</i>	Plains topminnow	Tier 1			x								G4	S4	
<i>Xyrauchen texanus</i>	Razorback sucker	Tier 1	LE	SE					x	x		x	G1	S1	
<i>Gila Pandora</i>	Rio Grande chub	Tier 1		SC	x	x							G3	S1	
<i>Oncorhynchus clarkii virginalis</i>	Rio Grande cutthroat trout	Tier 1	N	SC	x	x			x			x	G4T3	S3	
<i>Catostomus plebeius</i>	Rio Grande sucker	Tier 1		SE	x	x							G3G4	S1	
<i>Gila robusta</i>	Roundtail chub	Tier 1		SC	x	x			x	x		x	G3	S2	x
<i>Phoxinus erythrogaster</i>	Southern redbelly dace	Tier 1		SE	x						x		G5	S1	
<i>Noturus flavus</i>	Stonecat	Tier 1		SC						x			G5	S1	
<i>Phenacobius mirabilis</i>	Suckermouth minnow	Tier 1		SE								x	G5	S2	
MAMMALS															
<i>Ochotona princeps</i>	American pika**	Tier 1	N										G5	S5	
<i>Mustela nigripes</i>	Black-footed ferret	Tier 1	LE	SE						x		x	G1	S1	
<i>Myotis thysanodes</i>	Fringed myotis	Tier 1			x	x						x	G4	S3	
<i>Cynomys gunnisoni</i>	Gunnison's prairie dog	Tier 1	N		x	x			x			x	G5	S5	
<i>Myotis lucifigus</i>	Little brown myotis	Tier 1	P									x	G3	S5	
<i>Lynx Canadensis</i>	Lynx	Tier 1	LT	SE								x	G5	S1	
<i>Zapus hudsonius luteus</i>	New Mexico meadow jumping mouse	Tier 1	LE		x	x			x			x	G5T2	S1	
<i>Perognathus fasciatus</i>	Olive-backed pocket mouse	Tier 1										x	G5	S3	x
<i>Zapus hudsonius preblei</i>	Prebles meadow jumping mouse	Tier 1	LT	ST					x			x	G5T2	S1	x

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<i>Euderma maculatum</i>	Spotted bat	Tier 1			x	x						x	G4	S2	
<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	Tier 1		SC	x	x					x	x	G3G4T3T4	S2	
<i>Cynomys leucurus</i>	White-tailed prairie dog	Tier 1			x	x						x	G4	S4	
<i>Gulo gulo</i>	Wolverine	Tier 1	N	SE								x	G4	S1	
REPTILES															
<i>Aspidoscelis neotesselata</i>	Colorado checkered whiptail	Tier 1	N	SC					x	x		x	G2G3	S2	
<i>Sistrurus catenatus</i>	Massasauga	Tier 1	P	SC	x	x						x	G3G4	S2	
AMPHIBIANS															
<i>Acris blanchardi</i>	Blanchard's cricket frog	Tier 2		SC		x							G5	SH	
<i>Hyla arenicolor</i>	Canyon tree frog	Tier 2				x							G5	S2	
<i>Scaphiopus couchii</i>	Couch's spadefoot	Tier 2		SC									G5	S1	
<i>Spea intermontana</i>	Great Basin spadefoot	Tier 2				x							G5	S3	
<i>Gastrophryne olivacea</i>	Great Plains narrowmouth toad	Tier 2		SC									G5	S1	
<i>Anaxyrus debilis</i>	Green toad	Tier 2											G5	S2	
<i>Lithobates blairi</i>	Plains leopard frog	Tier 2		SC	x	x							G5	S3	
<i>Lithobates sylvatica</i>	Wood frog	Tier 2		SC	x								G5	S3	
BIRDS															
<i>Botaurus lentiginosus</i>	American bittern	Tier 2			x		x						G4	S3S4B	
<i>Falco peregrinus anatum</i>	American peregrine falcon	Tier 2		SC	x	x	x						G4T4	S2B	
<i>Pelecanus erythrorhynchos</i>	American white pelican	Tier 2				x							G4	S1B	
<i>Haliaeetus leucocephalus</i>	Bald eagle	Tier 2		SC	x	x	x						G5	S1B,S3N	

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<i>Patagioenas fasciata</i>	Band-tailed pigeon	Tier 2											G4	S4B	x
<i>Bucephala islandica</i>	Barrow's goldeneye	Tier 2											G5	S2B	
<i>Leucosticte atrata</i>	Black rosy-finch	Tier 2					x	x					G4	S4N	
<i>Cypseloides niger</i>	Black swift	Tier 2			x	x		x	x				G4	S3B	x
<i>Chlidonias niger</i>	Black tern	Tier 2			x								G4	S2B	
<i>Dolichonyx oryzivorus</i>	Bobolink	Tier 2						x					G5	S3B	x
<i>Aegolius funereus</i>	Boreal owl	Tier 2			x								G5	S2	
<i>Spizella breweri</i>	Brewer's sparrow	Tier 2			x	x	x						G5	S4B	x
<i>Peucaea cassinii</i>	Cassin's finch	Tier 2					x						G5	S5	x
<i>Aimophila cassinii</i>	Cassin's sparrow	Tier 2			x								G5	S4B	x
<i>Calcarius ornatus</i>	Chestnut-collared longspur	Tier 2			x		x	x					G5	S1B	x
<i>Buteo regalis</i>	Ferruginous hawk	Tier 2		SC	x	x	x					x	G4	S3B,S4N	
<i>Otus flammeolus</i>	Flammulated owl	Tier 2			x		x	x					G4	S4	
<i>Setophaga graciae</i>	Grace's warbler	Tier 2					x						G5	S3B	
<i>Ammodramus savannarum</i>	Grasshopper sparrow	Tier 2			x		x						G5	S3S4B	x
<i>Vireo vicinior</i>	Gray vireo	Tier 2					x	x					G4	S2B	
<i>Tympanuchus cupido</i>	Greater prairie-chicken	Tier 2			x			x					G4	S3	x
<i>Baeolophus ridgwayi</i>	Juniper titmouse	Tier 2					x						G5	S4	x
<i>Calamospiza melanocorys</i>	Lark bunting	Tier 2					x						G5	S4	x
<i>Passerina amoena</i>	Lazuli bunting	Tier 2											G5	S5B	x
<i>Sterna antillarum</i>	Least tern	Tier 2	LE	SE									G4	S1B	
<i>Melanerpes lewis</i>	Lewis's woodpecker	Tier 2			x		x						G4	S4	x

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<i>Lanius ludovicianus</i>	Loggerhead shrike	Tier 2			x								G4	S3S4B	x
<i>Numenius americanus</i>	Long-billed curlew	Tier 2		SC	x	x	x						G5	S2B	
<i>Rhynchophanes mccownii</i>	McCown's longspur	Tier 2			x		x						G4	S2B	
<i>Strix occidentalis lucida</i>	Mexican spotted owl	Tier 2	LT	ST									G3T3	S1B,SUN	
<i>Colinus virginianus</i>	Northern bobwhite	Tier 2											G5	S4	x
<i>Accipiter gentilis</i>	Northern goshawk	Tier 2			x	x							G5	S3B	
<i>Circus cyaneus</i>	Northern harrier	Tier 2			x								G5	S3B	
<i>Contopus cooperi</i>	Olive-sided flycatcher	Tier 2			x			x					G4	S3S4B	x
<i>Gymnorhinus cyanocephalus</i>	Pinyon jay	Tier 2					x	x					G5	S5	x
<i>Charadrius melodus</i>	Piping plover	Tier 2	LT	ST									G3	S1B	
<i>Falco mexicanus</i>	Prairie falcon	Tier 2					x						G5	S4B,S4N	
<i>Progne subis</i>	Purple martin	Tier 2			x								G5	S3B	
<i>Selasphorus rufus</i>	Rufous hummingbird	Tier 2						x					G5	SNA	x
<i>Amphispiza belli</i>	Sage sparrow	Tier 2			x								G5	S3B	x
<i>Asio flammeus</i>	Short-eared owl	Tier 2			x								G5	S2B	x
<i>Buteo swainsoni</i>	Swainson's hawk	Tier 2											G5	S5B	x
<i>Bartramia longicauda</i>	Upland sandpiper	Tier 2					x					x	G5	S3B	
<i>Catharus fuscescens</i>	Veery	Tier 2					x						G5	S3B	
<i>Oreothlypis virginiae</i>	Virginia's warbler	Tier 2						x					G5	S5	
<i>Charadrius alexandrinus nivosus</i>	Western snowy plover	Tier 2		SC		x	x						G3T3	S1B	
<i>Plegadis chihi</i>	White-faced ibis	Tier 2				x							G5	S2B	
<i>Grus Americana</i>	Whooping crane	Tier 2	LE	SE								x	G1	SNA	

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FISH															
<i>Etheostoma exile</i>	Iowa darter	Tier 2		SC									G5	S3	
<i>Couesius plumbeus</i>	Lake chub	Tier 2		SE	x						x		G5	S1	
MAMMALS															
<i>Sciurus aberti</i>	Abert's squirrel**	Tier 2											G5	S5	
<i>Idionycteris phyllotis</i>	Allen's big-eared bat	Tier 2				x							G4	SNR	
<i>Martes Americana</i>	American marten	Tier 2			x								G4G5	S4	
<i>Nyctinomops macrotis</i>	Big free-tailed bat	Tier 2				x							G5	S1	
<i>Ovis Canadensis</i>	Bighorn sheep	Tier 2			x	x							G4	S4	
<i>Bison bison</i>	Bison	Tier 2											G4	SX	
<i>Cynomys ludovicianus</i>	Black-tailed prairie dog	Tier 2	N	SC	x	x						x	G4	S3	
<i>Thomomys bottae rubidus</i>	Botta's pocket gopher (<i>rubidus</i> ssp.)	Tier 2		SC									G5T1	S1	
<i>Conepatus leuconotus</i>	Common hog-nosed skunk	Tier 2			x								G4	S1	
<i>Sorex nanus</i>	Dwarf shrew	Tier 2											G4	S2	
<i>Canis lupus</i>	Gray wolf	Tier 2	LE	SE	x							x	G4G5	SX	
<i>Ursus arctos</i>	Grizzly bear	Tier 2		SE									G4	SX	
<i>Lasiurus cinereus</i>	Hoary bat	Tier 2			x								G5	S5B	
<i>Vulpes macrotis</i>	Kit fox	Tier 2		SE	x	x							G4	S1	x
<i>Sorex preblei</i>	Preble's shrew	Tier 2											G4	S1	
<i>Brachylagus idahoensis</i>	Pygmy rabbit	Tier 2											G4	SNR	
<i>Sorex hoyi montanus</i>	Pygmy shrew	Tier 2			x								G5T3T4	S2	

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<i>Clethrionomys gapperi</i>	Red-backed vole**	Tier 2											G5	S5	
<i>Lontra Canadensis</i>	River otter	Tier 2		ST	x						x	x	G5	S3S4	
<i>Lemmiscus curtatus</i>	Sagebrush vole	Tier 2											G5	S1	
<i>Lepus americanus</i>	Snowshoe hare**	Tier 2											G5	S5	
<i>Vulpes velox</i>	Swift fox	Tier 2		SC	x	x						x	G3	S3	
<i>Lepus townsendii</i>	White-tailed jackrabbit	Tier 2											G5	S4	
MOLLUSKS															
<i>Ferrissia walker</i>	Cloche ancyloid	Tier 2											G4G5Q	S3	
<i>Promenetus umbilicatellus</i>	Cockerell	Tier 2											G4	S3	
<i>Anodontoides ferussacianus</i>	Cylindrical papershell	Tier 2		SC									G5	S2	
<i>Ferrissia fragilis</i>	Fragil ancyloid	Tier 2											G5Q	S1	
<i>Physa cupreonitens</i>	Hot springs physa	Tier 2											G5Q	S2	
<i>Uniomerus tetralasmus</i>	Pondhorn	Tier 2											G5	S1	
<i>Acroloxus coloradensis</i>	Rocky Mountain capshell	Tier 2		SC	x								G3	S1	
<i>Promenetus exacuouus</i>	Sharp sprite	Tier 2											G5	S2	
<i>Physa gyrina utahensis</i>	Utah physa	Tier 2											G5T2	S1	
REPTILES															
<i>Thamnophis cyrtopsis</i>	Black-necked gartersnake	Tier 2											G5	S2?	
<i>Lampropeltis californiae</i>	California kingsnake	Tier 2		SC		x							G5	S1	
<i>Thamnophis sirtalis</i>	Common gartersnake	Tier 2		SC									G5	S3	x
<i>Sceloporus magister</i>	Desert spiny lizard	Tier 2				x							G5	S2	
<i>Gambelia wislizenii</i>	Long-nosed leopard lizard	Tier 2		SC		x							G5	S1	

Colorado's 2015 State Wildlife Action Plan

Species	Common Name	Priority Tier	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	USFWS Birds of Conservation Concern	PIF US-Canada Watch List	CO's Contribution to Conservation	Urgency of Conservation Action	Ability to Implement Effective Conservation Actions	Ecological Value of the Species	NatureServe Global Status Rank	CNHP/NatureServe State Status Rank	Declining Trend
<i>Rhinocheilus lecontei</i>	Long-nosed snake	Tier 2											G5	S1?	
<i>Crotalus oreganus concolor</i>	Midget faded rattlesnake	Tier 2		SC		x							G5T4	S3?	
<i>Lampropeltis triangulum</i>	Milksnake	Tier 2				x							G5	S2?	
<i>Rena dissectus</i>	New Mexico threadsnake	Tier 2		SC									G4G5	S1	
<i>Hypsiglena chlorophaea</i>	Desert nightsnake	Tier 2											G5	S3	
<i>Phrynosoma modestum</i>	Round-tailed horned lizard	Tier 2		SC									G5	S1	
<i>Tantilla horbartsmithi</i>	Smith's black-headed snake	Tier 2											G5	S2?	
<i>Phrynosoma cornutum</i>	Texas horned lizard	Tier 2		SC									G4G5	S3	
<i>Kinosternon flavescens</i>	Yellow mud turtle	Tier 2		SC									G5	S1	

Chapter 3: Habitats

This chapter presents updated information on the distribution and condition of key habitats in Colorado. The habitat component of Colorado's 2006 SWAP considered 41 land cover types from the Colorado GAP Analysis (Schrupp et al. 2000). Since then, the Southwest Regional GAP project (SWReGAP, USGS 2004) has produced updated land cover mapping using the U.S. National Vegetation Classification (NVC) names for terrestrial ecological systems. In the strictest sense, ecological systems are not equivalent to habitat types for wildlife. Ecological systems as defined in the NVC include both dynamic ecological processes and biogeophysical characteristics, in addition to the component species. However, the ecological systems as currently classified and mapped are closely aligned with the ways in which Colorado's wildlife managers and conservation professionals think of, and manage for, habitats. Thus, for the purposes of the SWAP, references to the NVC systems should be interpreted as wildlife habitat in the general sense.

Fifty-seven terrestrial ecological systems or altered land cover types mapped for SWReGAP have been categorized into 20 habitat types, and an additional nine aquatic habitats and seven "Other" habitat categories have been defined. SWAP habitat categories are listed in Table 4 (see Appendix C for the crosswalk of SWAP habitats with SWReGAP mapping units). Though nomenclature is slightly different in some cases, the revised habitat categories presented in this document are consistent with those defined in the 2006 SWAP with the following exceptions:

- Douglas Fir and White Fir, formerly stand-alone habitat categories, have been included in the Mixed Conifer category;
- Limber Pine and Bristlecone Pine have been combined into Subalpine Limber and Bristlecone Pine;
- Tallgrass Prairie and Midgrass Prairie have been combined into Mixed-grass and Tallgrass Prairies;
- Sand Dune Complex (Grassland) and Sand Dune Complex (Shrubland) have been combined into the Sandsage category, and a separate Sand Dunes category has been added to distinguish sandy prairie habitats from true sand dune habitats;
- Meadow Tundra and Shrub Tundra, formerly stand-alone categories, have been combined under Alpine;
- Exposed Rock has been split into Alpine (high elevation bedrock, screen, ice fields and fellfields) and Cliffs & Canyons (cliffs, canyons, outcrops, and tablelands of Rocky Mountains, Western Great Plains, and Intermountain Basins)
- A Riparian Woodlands and Shrublands category has been added to better distinguish terrestrial stream-side habitats from aquatic habitats.

A widely-accepted, broad-scale classification comparable to the NVC does not currently exist for aquatic habitats. For the 2006 SWAP, we defined aquatic habitat categories that had meaning for wildlife managers and stakeholders. For this iteration of the SWAP, we have revised the original aquatic habitat categories to more explicitly relate aquatic habitats to associated physiographic regions. Watershed characteristics such as elevation, vegetation and geology strongly influence key aspects of aquatic habitat such as gradient, temperature, and turbidity, which in turn shape aquatic species distributions within the state. Changes to aquatic habitat categories are:

- West Slope Rivers and West Slope Streams have been re-categorized as Colorado Plateau – Wyoming Basins Rivers and Streams;
- Rio Grande Valley Rivers and Streams have been added as unique habitat categories;
- Lakes and Open Water categories have been revised to distinguish natural lakes (still the Lakes category) from other types of open water and associated habitats (now split into the Reservoirs & Shorelines and Hot Springs categories).

Table 4. Wildlife habitats in Colorado.

Habitat Type	Habitat Community
Forest	Aspen
Forest	Lodgepole Pine
Forest	Mixed Conifer
Forest	Pinyon-Juniper
Forest	Ponderosa Pine
Forest	Spruce-Fir
Forest	Subalpine Limber-Bristlecone Pine
Shrub	Desert Shrub
Shrub	Greasewood
Shrub	Oak and Mixed Mountain Shrublands
Shrub	Sagebrush
Shrub	Saltbush
Shrub	Sandsage
Shrub	Upland Shrub
Grassland	Foothill and Mountain Grasslands
Grassland	Mixed and Tallgrass Prairies
Grassland	Shortgrass Prairie
Riparian and Wetland	Playas
Riparian and Wetland	Riparian Woodlands and Shrublands
Riparian and Wetland	Wetlands
Aquatic	Colorado Plateau - Wyoming Basins Rivers
Aquatic	Colorado Plateau - Wyoming Basins Streams
Aquatic	Eastern Plains Rivers
Aquatic	Eastern Plains Streams

Habitat Type	Habitat Community
Aquatic	Lakes
Aquatic	Mountain Streams
Aquatic	Rio Grande Valley Rivers
Aquatic	Rio Grande Valley Streams
Aquatic	Transition Zone Streams
Other	Agriculture
Other	Alpine
Other	Cliffs and Canyons
Other	Conservation Reserve Program (CRP)
Other	Hot Springs
Other	Reservoirs and Shorelines
Other	Sand Dunes

Distribution and Condition of Habitats

Figure 1 shows the distribution of terrestrial habitats dominated by native vegetation. Figure 2 shows the distribution of aquatic habitats. Some habitats that occur in small patches are not detectable when displayed on a letter-size statewide map. These include many lakes, wetlands, playas, and hot springs, as well as some riparian areas. Where data were available for these small-patch habitats, habitat features have been enhanced for readability in Figure 1. Finer scale mapping of wetlands in Colorado has been developed through a partnership between the U.S. Fish and Wildlife’s National Wetland Inventory Program, U.S. Environmental Protection Program, the Colorado Natural Heritage Program, and Colorado Parks and Wildlife. Playas have been mapped by Playa Lakes Joint Venture and Rocky Mountain Bird Observatory⁶. Three types of agricultural land uses provide wildlife habitat in Colorado: rangeland, cropland, and Conservation Reserve Program (CRP) lands. Rangeland is included under the grassland habitat types. Cropland and CRP are treated as separate habitat types, but current spatial data at a statewide scale are not available; thus, these two habitats do not appear on Figure 1.

Brief descriptions of each habitat follow. Portions of habitat summaries have been excerpted, with permission, from Rondeau et al. 2011, CNHP 2005-2007, and NatureServe 2014, with modifications where necessary to accurately reflect revised SWAP habitat categories. Information related to general habitat condition has been summarized from these and other sources (e.g., Colorado’s 2013 Forest Health Report), and from ecosystem experts at the Colorado Natural Heritage Program.

Tables 7 and 8 list the SGCN that are associated with each habitat type, by species and by habitat, respectively. SGCN for which the habitat is a primary habitat are marked. For the purposes of this SWAP, “primary habitat” refers to the habitat(s) in which a species is most typically found,

⁶ For the most recent data available, contact the Colorado Natural Heritage Program, www.cnhp.colostate.edu for wetlands and Bird Conservancy of the Rockies, www.birdconservancy.org, for playas.

or that is crucial to the completion of one or more phases of the species' life cycle. Simplifying the complex factors that constitute "habitat" into broad categories that can be mapped at a statewide scale is always going to be an imperfect process. The species/habitats relationships in Tables 7 and 8 do not always recognize small-scale nuances. For example, grouse are known to use wet meadows interspersed within shrubland communities for brood rearing. However, these features are often not mappable at a statewide scale. Furthermore, these wet meadows are distinct from the statewide habitat category for "wetlands." So even though grouse require moist habitats, including the wetland habitat category, as defined for this SWAP, would be inappropriate. Local scale conservation work should always be based on site-specific conditions.

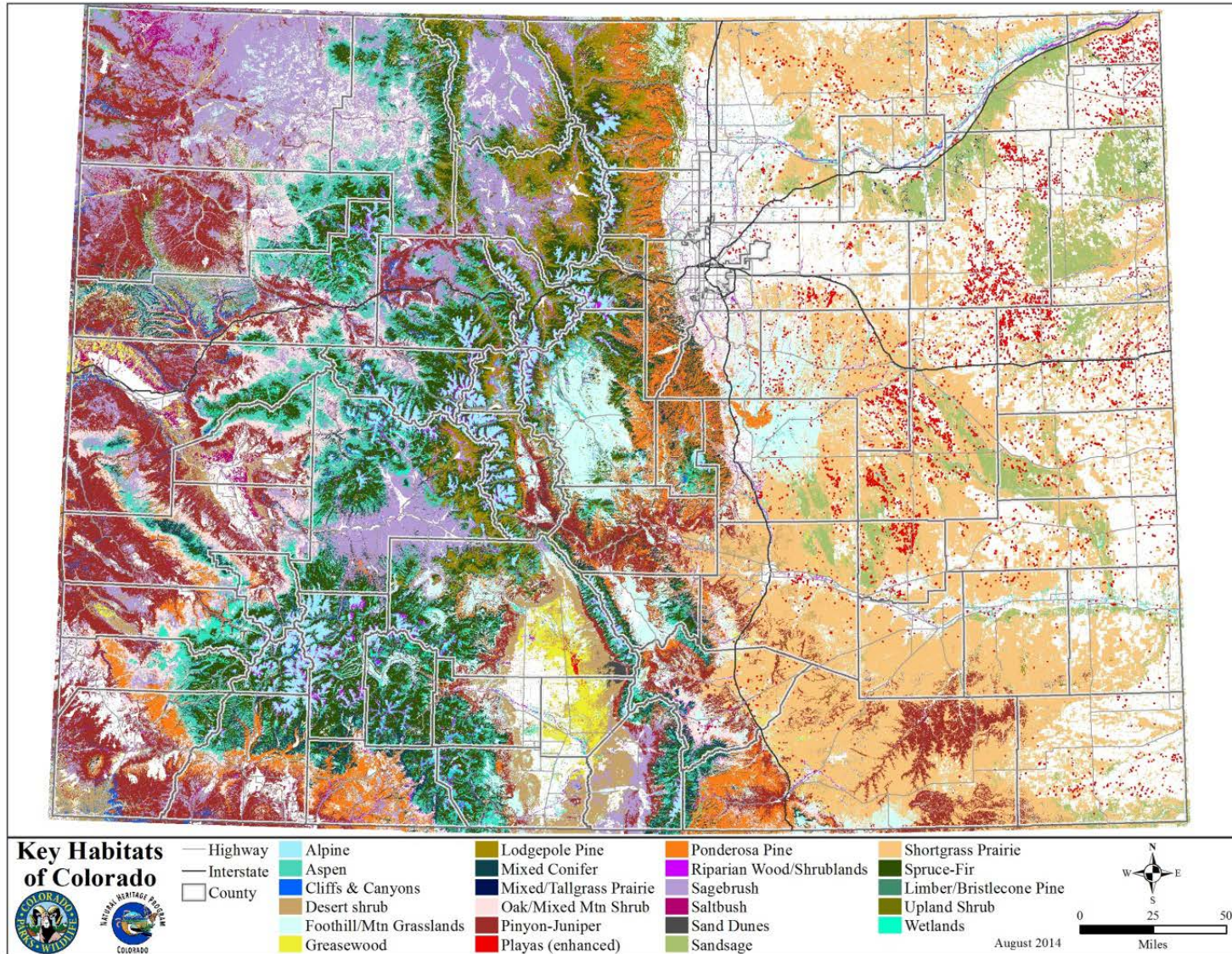


Figure 1. Distribution of key terrestrial habitats in Colorado.

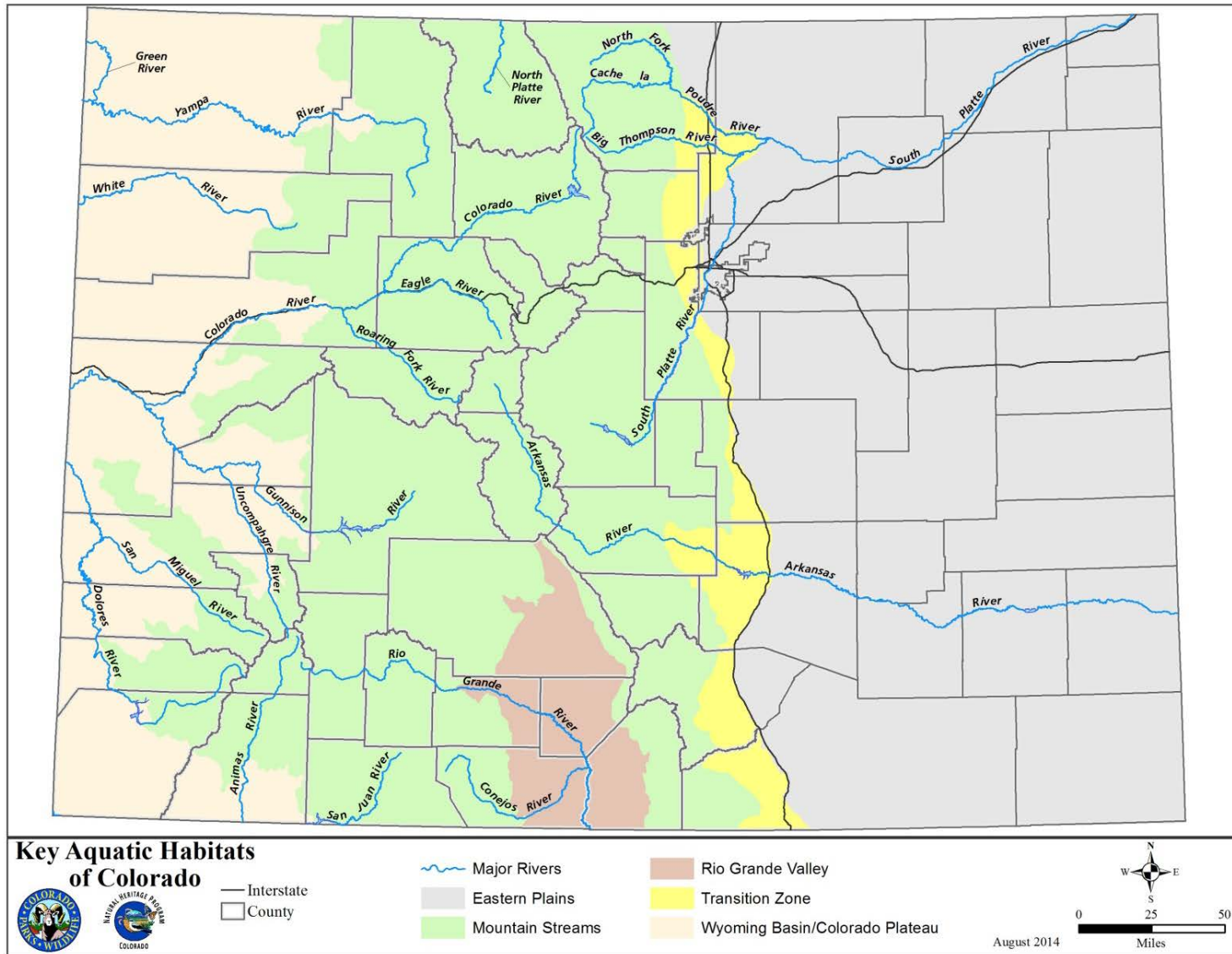


Figure 2. Distribution of key aquatic habitats.

FOREST AND WOODLAND HABITATS

Aspen

Aspen supports 29 SGCN (Table 8). In Colorado, aspen forests are quite common on the western slope, with smaller stands represented on the east slope. These forests cover more than three and a half million acres in Colorado, including one patch of more than a half million acres on the edges of the White River Plateau and Flat Tops. These are upland forests and woodlands dominated by quaking aspen (*Populus tremuloides*), ranging in elevation from about 7,500 to 10,500 feet. Aspen forests and woodlands usually contain a mosaic of many plant associations and may be surrounded by a diverse array of other ecological systems, including grasslands, wetlands, and coniferous forests.

Primary threats to aspen forests in Colorado include fire suppression, excessive browsing (especially by elk), and Sudden Aspen Decline (SAD), which is especially troublesome in the southwestern portion of the state (CSFS 2010). The cause(s) of SAD are unclear and research to identify stressors is on-going. Currently, SAD is not widely distributed across the state, but there is potential for this condition to pose a more significant threat to our aspen forests in the future if the underlying causes are exacerbated by changing climatic conditions. Aspens have increased susceptibility to episodic decline at lower elevations under warm and dry conditions (Worrall et al. 2008). SAD appears to be related to drought stress, and is typically greatest on the hotter and drier slopes, which are usually at the lowest elevations of a stand (Rehfeldt et al. 2009). Stands may undergo thinning, but then recover. Increasing drought with climate change is believed to be the primary vulnerability of this ecosystem (Worrall et al. 2013), and substantial loss of aspen can potentially be expected. However, from a statewide perspective, aspen forests are currently in generally good condition overall and threats are comparatively low.

Lodgepole

Lodgepole forests, which cover more than two million acres in Colorado, support 21 SGCN (Table 8). In Colorado, lodgepole is widespread between 8,000-10,000 feet in elevation, on gentle to steep slopes of the Rocky Mountains in the northern part of the state. Stands may be pure lodgepole pine (*Pinus contorta*), or mixed with other conifer species. Following stand-replacing fires, lodgepole pine rapidly colonizes and develops into dense, even-aged stands (sometimes referred to as “dog hair” stands). Lodgepole pine forests typically have shrub, grass, or barren understories, sometimes intermingled with aspen. Shrub and groundcover layers are often sparse in lodgepole pine forests. Diversity of plant species is also low, perhaps as a result of the uniform age and dense canopy of many stands.

Although these forests are common across Colorado, most have experienced widespread damage from a severe outbreak of mountain pine beetle (*Dendroctonus ponderosae*). The pine beetle is a native species, and periodic outbreaks of this insect are part of the natural cycle that maintains our mountain forests. After killing approximately 3.4 million acres of lodgepole forests over the past decade, this recent outbreak is finally beginning to subside, primarily due to the fact that most susceptible host trees have been killed (CSFS 2013). Regeneration has been rapid in beetle-kill areas, and many large vegetation management projects have been completed and are underway on public lands to remove dead trees. Although there has been widespread mortality, and remaining lodgepole forests have been “re-set” to an early seral stage, this situation is part of the natural life cycle of a forest – thus, current condition cannot really be considered “bad.”

Preliminary results of our climate change vulnerability assessment suggest that lodgepole may be moderately vulnerable through mid-century. Warming temperatures favor the growth of lodgepole pine, at least under conditions of increased precipitation, which may occur in some portions of the state. Warmer winters with drought are likely to increase mountain pine beetle outbreaks, but mortality is already widespread. Lodgepole habitat may be fairly resilient to climate change, and likely to persist, even if in an altered form.

Mixed Conifer

Mixed conifer supports 35 SGCN (Table 8). Mixed conifer forests occur at elevations ranging from 4,000 to 10,800 feet, and covers more than 850,000 acres in Colorado. Douglas-fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor*) are the most common dominant trees, but as many as seven different conifer species may be present. Douglas-fir stands are characteristic of drier sites, often mixed with ponderosa pine (*Pinus ponderosa*). More mesic stands are found in cool ravines and on north-facing slopes, and are likely to be dominated by white fir with blue spruce (*Picea pungens*) or quaking aspen (*Populus tremuloides*) stands. Natural fire processes in this ecological system are highly variable in both return interval and severity, with fire cycles ranging from 20 to more than 150 years. Stands in the Front Range are vulnerable to the impacts of housing development, and some are in degraded condition (i.e., denser, with more dead fuel) as a result of fire suppression (CSFS 2010). However, many of these habitats are generally in good condition, with minimal threats.

Pinyon-Juniper

Pinyon-juniper, which covers almost 7 million acres in Colorado, supports 67 SGCN (Table 8). Pinyon-juniper habitat includes juniper (*Juniperus* spp.) savannas and woodlands, woodlands and shrublands co-dominated by pinyon pine (*Pinus edulis*) and juniper, and some stands of juniper mixed with limber pine (*Pinus flexilis*) at lower elevations. Various forms of pinyon-juniper occur on mesas, dry mountains, and foothills across the western slope as well as in south-

central and southeastern Colorado. The understory is highly variable, and may be shrubby, grassy, sparsely vegetated, or rocky. Elevation ranges from 4,900 - 9,000 feet. In the canyons and tablelands of the southern Great Plains, juniper woodlands form extensive cover at some distance from the mountain front, at elevations from 4,100 to 6,200 feet.

For the purpose of analysis under the SWAP, the two major and four minor types of pinyon-juniper habitats classified under ReGAP have been lumped together. There are only two major pinyon-juniper systems – the Colorado Plateau system on the western slope, and the Southern Rockies system on the eastern slope. The Southern Rockies system is restricted to relatively discrete areas in the southeastern part of the state. The other four types can be significant on a local scale, but do not warrant separate treatment in statewide analyses such as the SWAP. Although localized threats exist, the size, juxtaposition, and broad distribution of this plant community affords a resiliency lacking in most other vegetation communities across Colorado.

Pinyon-juniper is influenced by climate, grazing, fires, and insect-pathogen outbreaks. Since the late 1800s, many of these woodlands have been significantly altered by changes in fire frequency, grazing patterns, habitat treatments, and climate cycles.

Recent studies (Eisenhart 2004; Romme et al. 2009) indicate that pinyon-juniper stands on the western slope are shaped predominantly by large, stand replacing fires that occur in 300-500 year intervals. Such fires would be followed by long recovery periods where the site is dominated by forbs and grasses, then shrubs, followed eventually by the re-establishment of a pinyon-juniper climax community. This scenario yields a very large range in historic variability and makes modeling past or future distribution of pinyon-juniper forests across the state difficult at best. In this habitat, fire acts to open stands, increase diversity and productivity in understory species, and create a mosaic of stands of different sizes and ages across the landscape while maintaining the boundary between woodlands and adjacent shrubs or grasslands. Altered fire regimes, drought, overgrazing, and tree cutting can affect stand quality and the potential encroachment of trees into adjacent habitats.

Pinyon-juniper habitat quality has declined compared to historic norms, as significant acreage has been chained and burned in an effort to increase forage for livestock and big game on productive sites. Other threats include urban development, recreation (especially motorized recreation), invasive species (most notably an increase in cheatgrass (*Bromus tectorum*) in the understory, which has led to increasing fire ignitions), and energy development. In comparison with pinyon-juniper stands, Colorado's juniper-only woodlands have been much less impacted by human activities. However, the extent of juniper woodlands has historically been limited by fire, which kills juniper trees. Fire suppression and drought may have caused an expansion of juniper woodlands in some areas of southeast Colorado, where most of the junipers not associated with rimrock are young trees (<100 years old).

Pinyon-juniper habitats across Colorado are in generally fair to good condition, and are excellent in more remote, untreated or administratively protected areas. Some patches can be in poor condition in areas where incompatible grazing has reduced native bunch grasses and invasive species such as cheatgrass have become established. Overgrazing can also result in a complete lack of understory in mature pinyon-juniper stands. Oil and gas development, and chaining to improve livestock forage, have degraded the condition of some stands. Climate change may result in additional degradation of this habitat type, especially via an increase in frequency and/or severity of wildfire. In some previously burned areas, pinyon-juniper is not regenerating. For example, roughly 50% of Mesa Verde National Park burned in the early 1990s. At this time, there is still no sign of pinyon-juniper regeneration. Instead, burned areas have been invaded by cheatgrass and smooth brome (*Bromus inermis*). Preliminary results of our climate change vulnerability assessment suggest that pinyon-juniper may be moderately vulnerable to climate change through mid-century. The pinyon-juniper habitat has large ecological amplitude; warmer conditions may allow expansion, as has already occurred in the past centuries, as long as there are periodic cooler, wetter years for recruitment. Increased drought may drive fires and insect outbreaks, from which these woodlands would be slow to recover.

Although a large number of animal species in Colorado use pinyon-juniper habitats, few are wholly dependent upon them, with the exception of birds. It may be that the cyclic nature of these plant communities has forced many animals using them to remain adaptable. The primary mast crops produced in a pinyon-juniper community can vary widely from year to year, largely in response to precipitation and frost patterns. The best strategy may be to take advantage of this food source when available, but not to depend upon it for long term survival. This makes the pinyon-juniper forests of Colorado significant to wildlife, but more in a generalist, and not an obligate fashion. For birds, however, pinyon-juniper supports one of the highest proportions of obligate or semi-obligate bird species among forest types (Paulin et al. 1999). Thirty-nine percent of bird species found in pinyon-juniper are obligate or semi-obligate, second only to riparian forested communities (Paulin et al. 1999); 20% of bird species that use pinyon-juniper (roughly one-quarter of Colorado's native birds) are obligates (Kingery 1998).

Ponderosa Pine

Ponderosa pine supports 34 SGCN (Table 8). In Colorado, ponderosa pine (*Pinus ponderosa*) woodlands cover about 3.2 million acres in Colorado. They occur between about 6,000 and 9,000 feet, often at the lower treeline transition between grassland or shrubland and the more mesic coniferous forests above. These woodlands are especially prevalent along the eastern edge of the Rocky Mountains, and on the southern flank of the San Juan Mountains. Healthy ponderosa pine forests often consist of open and park-like stands of mature trees, with an understory of predominantly fire-tolerant grasses and forbs. Fire is the most significant ecological process

maintaining this ecological system; frequent, low-intensity ground fires are typical. Older trees drop their lower branches and develop thick, insulating bark as they age, which protects them from ground fires. In stands where the natural fire regime occurs, shrubs, understory trees and downed logs are uncommon. When fires are not allowed to burn, young trees continue to grow, and places that were once open savannas and woodlands become dense forests. Increased density of trees allows fires to reach the forest canopy, spread rapidly, and burn large areas.

In southwestern Colorado, the overall condition of ponderosa pine is generally good, except where exurban development has fragmented larger stands. On the Front Range, many stands have been lost to urban development, and some of the remaining stands are in degraded condition. The likelihood of future threats (primarily development and fire suppression) is high. Preliminary results from our climate change vulnerability assessment suggest that ponderosa pine may be moderately vulnerable through mid-century. Increased drought may drive fires and insect outbreaks, and relative proportions of component species in ponderosa stands may change. This habitat is well adapted to warm, dry conditions if precipitation is not reduced too much, and may be able to expand into higher elevations.

Spruce-Fir

Spruce-fir forests support 23 SGCN (Table 8). Spruce-fir forests cover about 5% of Colorado's landscape, forming the matrix vegetation of the sub-alpine zone at elevations of 9,500 to 11,500 feet. They are characterized by dense stands of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*). This is one of the few Colorado forest types that is not fire-adapted – the typical fire return frequency is around 400 years. Areas with spruce-fir forest typically receive precipitation in the form of snowfall and frequent summer showers. When periods of drought occur, however, the stressed trees become susceptible to spruce-bud worm (*Choristoneura freemani*) and spruce beetle (*Dendroctonus rufipennis*) outbreaks, which can kill entire hillsides of trees in one summer. In the early 20th century, much of Colorado's old-growth spruce fir was cut for timber. Although much spruce-fir is now made up of younger trees, it is still possible to find very old, widely-spaced trees with yellow bark, as well as snags and downed trees that create perfect habitat for cavity-nesting birds and pine martens.

In 2013, spruce beetle infestations were identified on 398,000 acres, the majority of which are in the southwestern mountain ranges (CSFS 2013). However, from a statewide perspective, spruce-fir forests are generally healthy and intact, except that small stand size detracts from the overall quality of the habitat in some areas. Although this habitat is heavily used for recreation and other human activities, overall threats are relatively low at this time. Global climate change may have significant impacts on spruce-fir in the future. Preliminary results of our climate change vulnerability assessment suggest that spruce-fir is moderately vulnerable until mid-century. Under warmer conditions, spruce-fir is likely to expand into alpine areas, but the response would

be slow. The lower distributional limit of this habitat is likely to move higher under warmer, drier conditions. Change in species composition may occur in some areas. The vulnerability of this habitat might be higher if the analysis timeframe were further out than mid-century.

Subalpine Limber and Bristlecone Pine

Limber and bristlecone pine forests and woodlands support 12 SGCN (Table 8). This habitat occurs throughout the Rocky Mountains on dry, rocky ridges and slopes. Although it can be found near upper treeline above spruce-fir forests, it also occurs at lower elevations. These are typically woodlands of xeric, high elevation sites, but they may also extend down to the lower montane, particularly along the Front Range. Limber pine (*Pinus flexilis*) and bristlecone pine (*Pinus aristata*) do not necessarily occur together, but the two species occupy a similar ecological niche. Where the two co-occur, limber pine is often confined to the lower portion of its potential habitat. Bristlecone pine is more-or-less endemic to the Southern Rocky Mountain ecoregion, reaching its northernmost station in Gilpin County, Colorado. Limber pine is more widely distributed and also occurs in mixed conifer systems. It largely replaces bristlecone pine north of I-70, and extends onto the plains in small but important habitat patches on the Pawnee National Grasslands.

This habitat occurs in harsh sites that are exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Higher elevation occurrences are found well into the subalpine – alpine transition on wind-blasted, mostly south to west-facing slopes and exposed ridges. Bristlecone forests are typically found on steep, south-facing slopes from 8,850 to 12,140 feet. Limber pine woodlands occupy similar habitats, but may occur at lower elevations than bristlecone. Both bristlecone and limber pine are slow-growing, long-lived species in which individuals may live for 1,000 or more years. Fire is an important source of disturbance that facilitates stand regeneration in this system. Older woodlands are often broadly even-aged stands where seedlings are nearly absent, while areas that have recently burned may have abundant seedlings. Bristlecone is somewhat more tolerant of fire than is limber pine, but both species appear to depend on fire for regeneration. Regeneration of limber pine on burned areas is largely due to the germination of seeds cached by Clark's nutcrackers (*Nucifraga columbiana*). The slow growth and recruitment of bristlecone and limber pine will make it difficult for these habitats to colonize new areas under changing climate conditions. Furthermore, warmer conditions may increase the vulnerability of these pines to white pine blister rust.

SHRUBLAND HABITATS

Desert Shrub

Desert shrub supports 37 SGCN (Table 8). In Colorado, these semi-arid shrubby grasslands, sometimes referred to as shrub steppes, are found between 7,500 and 9,500 feet in elevation, on windswept mesas, valley floors, gentle slopes, and on shoulders of ridges. Our shrub-steppes are grass-dominated areas with an open shrub layer. Typical grass species include blue grama (*Bouteloua gracilis*), needle-and-thread (*Hesperostipa comata*), galleta (*Pleuraphis jamesii*), saltgrass (*Distichlis spicata*), Indian rice grass (*Acnatherum hymenoides*), and alkali sacaton (*Sporobolus airoides*). Historically, the shrub layer was dominated by winterfat (*Krascheninnikovia lanata*), but this species has decreased under grazing pressure in many areas. Winterfat has been replaced by rabbitbrush (*Ericameria* and *Chrysothamnus*) species and other woody shrubs. In Colorado, this ecological system does not form extensive stands except in the San Luis Valley. Pinyon-juniper woodlands and sagebrush shrublands commonly occur adjacent to this ecological system at the upper elevations. Shrub steppe covers more than 750,000 acres in Colorado. Historically, it probably accounted for well over a million acres, but many areas were converted to agricultural use. Remaining stands are generally in good condition, except for altered species composition in areas where grazing has reduced or eliminated some native bunch grasses. Solar energy development in the San Luis Valley and continued alteration by grazing are the primary potential threats to this ecological system. Thus far, solar energy development has mostly occurred on land that was previously converted to cropland, so this activity does not yet necessarily constitute additional loss.

Greasewood

Greasewood supports 17 SGCN (Table 8). Shrublands dominated by black greasewood (*Sarcobatus vermiculatus*) account for less than 450,000 acres in Colorado, where they are typically found near drainages on stream terraces and flats, on alluvial fans along streams or arroyos, or as rings around playas. In eastern Colorado, greasewood stands are primarily in the southwestern portion of the plains. Large acreages are also found in the lower elevations of Colorado's western valleys and throughout much of the San Luis Valley. Greasewood flats usually have saline soils, a shallow water table and flood intermittently, but remain dry for most of the growing season. Because greasewood flats are tightly associated with saline soils and groundwater that is near the surface, groundwater recharge rather than surface water flow is critical for maintaining these shrublands. Elevations range from about 4,000 to 7,700 feet. These open to moderately dense shrublands are dominated by black greasewood, often with rabbitbrush (*Ericameria* and *Chrysothamnus* spp.), four-wing saltbush (*Atriplex canescens*), and alkali sacaton grass (*Sporobolus airoides*). Threats to greasewood include groundwater pumping,

conversion to cropland, and energy development. However, the condition of greasewood habitats in Colorado remains generally good.

Oak and Mixed Mountain Shrub

Oak and mixed mountain shrublands, which account for about 2.7 million acres in Colorado, support 30 SGCN (Table 8). Oak and mixed mountain shrublands generally occur at elevations from approximately 6,500 to 9,500 feet, where they are often adjacent to lower elevation pinyon-juniper woodlands. Gambel's oak (*Quercus gambelii*) is typically dominant, but very often mixed with other montane shrubs such as serviceberry (*Amelanchier* spp.), mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), big sagebrush (*Artemisia tridentata*), chokecherry (*Prunus virginiana*), and snowberry (*Symphoricarpos* spp.). These shrublands intergrade with foothills shrublands (roughly equivalent to the Upland Shrub habitat category) because both types are often found on poor, dry soils. In Colorado, oak and mixed mountain shrublands are most common on the western slope, where they form extensive bands on the lower mountain slopes, plateaus, and dry foothills. In eastern Colorado, these shrublands are also found at the mountain front as far north as the Palmer Divide. They may form dense thickets, or occur as open shrublands with an herbaceous understory. Although this is a shrub-dominated ecological system, some trees may be present.

Fire typically plays an important role in oak and mixed mountain shrublands, causing shrub die-back in some areas, promoting re-sprouting from stumps or underground tubers and rhizomes in other areas, and controlling the invasion of trees into the shrublands. Healthy examples of this habitat contain shrubs of varying heights, a robust understory of native bunchgrasses and forbs, and relatively little bare ground (COPiF 2000). Shrubs that produce acorns and berries provide valuable food and cover resources for a variety of wildlife species.

Where oak and mixed mountain shrublands occur near the wildland-urban interface, they are often in degraded condition due to effects from fire suppression. Ongoing impacts include housing development and oil and gas development. However, oak and mixed mountain shrublands are in generally good condition from a statewide perspective. Preliminary results from our climate change vulnerability assessment suggest that oak and mixed mountain shrub habitats have low vulnerability in Colorado. Warmer temperatures may increase seedling survival.

Sagebrush

Sagebrush supports 65 SGCN (Table 8). Sagebrush in Colorado includes the three subspecies of big sagebrush (basin big sagebrush, *Artemisia tridentata* ssp. *tridentata*; mountain big sagebrush, *A. tridentata* ssp. *vaseyana*; and Wyoming big sagebrush, *A. tridentata* ssp. *wyomingensis*) that

occur as shrublands and montane sagebrush steppe. These shrublands occur throughout much of the western United States. Although they can be found on Colorado's east slope, the largest occurrences are on the western slope. North Park, Middle Park, and the upper Gunnison Basin have extensive stands of sagebrush shrublands, as do Moffat and northwest Rio Blanco counties. Big sagebrush shrublands are characterized by dense stands of taller sagebrush species with a significant herbaceous understory, and are generally found at elevations from 5,000 to 7,500 feet. Big sagebrush shrublands are typically found in broad basins between mountain ranges, on plains and foothills. Montane sagebrush steppe shrublands are dominated by the shorter sagebrush *Artemisia tridentata* ssp. *vaseyana*, and are usually found at elevations from 7,000 to 10,000 feet. Montane sagebrush steppe primarily occurs on ridges, near flat ridgetops, and mountain slopes.

Many of Colorado's sagebrush shrublands are vulnerable to changes induced by domestic livestock grazing. Prolonged use can cause a decrease in the abundance of native grasses and forbs in the understory, and an increase in shrubs and non-native grasses such as Kentucky bluegrass (*Poa pratensis*). Trampling from livestock grazing significantly decreases the survival of sagebrush and grass seedlings. Over the past century, the condition of much of Colorado's sagebrush shrubland has been degraded due to fire suppression and heavy livestock grazing. Although many livestock operations are now more sensitive in their treatment of sagebrush shrublands than they once were, recovery in these ecological systems is slow. Furthermore, many remaining sagebrush patches are now being fragmented by fast-paced and widespread energy development.

Various climate change vulnerability assessments for sagebrush have produced differing results (e.g., Nydick et al. 2012; Schlaepfer et al. 2012; Pocewicz et al. 2014), with rankings ranging from highly vulnerable to likely to increase, depending on the scale, location, and method of assessment. The Colorado-specific climate change vulnerability assessment conducted for this SWAP suggested that sagebrush is not particularly vulnerable in Colorado. Seasonal timing of precipitation is important for sagebrush habitats. Summer moisture stress may be limiting if winter precipitation is low, and increased drought may increase fire frequency/severity, eliminating sagebrush in some lower elevation areas. However, the habitat is not expected to be limited by lack of cooler habitat, since it can move to adjacent higher elevations. While some stands of sagebrush, especially those dominated by the *wyomingensis* subspecies, may be vulnerable, overall, sagebrush has numerous life history strategies that may help it adapt (e.g., it is a relatively short-lived shrub, it produces numerous seeds, and it can tolerate some droughts). Note that while the sagebrush habitat within Colorado does not appear to be particularly vulnerable to climate change, some sagebrush obligate species – most notably the Gunnison sage-grouse – are thought to be extremely vulnerable (Neely et al. 2011).

Saltbush

Saltbush supports 33 SGCN (Table 8). Saltbush includes salt desert scrub, mat saltbush shrublands, and shale badlands. All of these ecological system types are typically dominated by saltbush (*Atriplex*) species or other shrubs tolerant of saline or alkaline soils. These sparse to moderately dense low-growing shrublands are widespread at lower elevations (generally from 4,500 to 7,000 feet) in Colorado's western valleys, and are also found in more limited distribution in the southern part of the eastern plains. In mixed salt desert scrub, the shrub layer may include winterfat (*Krascheninnikovia lanata*), wolfberry (*Lycium*), horsebrush (*Tetradymia canescens*), and various sagebrush (*Artemisia*) species. Grasses and forbs are generally sparse, and dominated by species tolerant of the harsh soils. Some areas are essentially barren, or very sparsely vegetated. Saltbush covers more than 750,000 acres in Colorado. Perhaps a quarter of the historic acreage of saltbush shrublands has been converted to agricultural use, especially in valley bottoms where irrigation is available. Remaining occurrences appear to be in good condition. Impacts and fragmentation from energy development are the most current threats to this habitat.

Sandsage

Sandsage supports 21 SGCN (Table 8). Sandsage shrublands dominate sandy areas on Colorado's eastern plains, where they often intermingle with shortgrass prairie to form a locally patchy sandsage-shortgrass matrix. Sandsage is characterized by sand sagebrush (*Artemisia filifolia*) with an understory of tall, mid- and short grasses and scattered forbs. Yucca (*Yucca glauca*) and snakeweed (*Gutierrezia sarothrae*) are common in some areas, which may be indicative of mismanagement. Fire and grazing are the most important dynamic processes for sandsage, although drought stress can impact this ecological system significantly in some areas. Sandsage covers nearly two million acres in Colorado. These sandy-soiled habitats have frequently been passed over while neighboring grasslands are converted to agriculture, but about 20% of historic acreage has been lost, and sandsage areas continue to be converted to row crop production. Although remaining sandsage tracts generally have good landscape context and connectivity, species composition in these areas is highly altered by long-term mismanaged grazing. Understory grasses have been converted to short grass or annual species, and historic mixed and tall grass components are lacking, with consequent detrimental effect on habitat quality for several SGCN. Sandsage is vulnerable to adverse impacts from energy development (including wind, oil, and gas).

Preliminary results from our climate change vulnerability assessment suggest that sandsage is moderately vulnerable through mid-century. This habitat is not vulnerable on sandy soils, and may be able to expand into adjacent areas under warmer, drier conditions. However, overall condition and composition of these shrublands may change.

Upland Shrub

Upland shrub habitats, which cover less than 400,000 acres in Colorado, support 27 SGCN (Table 8). Upland shrub habitats are found in dry, upland areas where oak is not present. This habitat is found in the Rocky Mountain foothills, ridges, canyons and lower mountain slopes, and on outcrops, mesas, and canyon slopes of the eastern plains. In general, mixed shrublands without oak are most common in the northern Front Range, as well as on drier foothills and prairie hills. Upland shrub occurs at elevations between 4,900-9,500 feet. Scattered trees may be present, but the vegetation is dominated by shrubs such as mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), skunkbush sumac (*Rhus trilobata*), or currant species (*Ribes* spp.). The dominant shrub species are generally well adapted to poor soils, dry sites, and disturbance by fire. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth. Threats to upland shrub include fragmentation by roads and development. These disturbances provide an unnatural fire break as well as a conduit for weed invasion.

Condition of upland shrub habitats is generally good across Colorado, with fair patches in some areas. The shrub layer is good to excellent, but the understory layer is generally fair to poor. This habitat is vulnerable to weed invasions. Where invasive species such as leafy spurge (*Euphorbia esula*) and cheatgrass (*Bromus tectorum*) have established, understories are highly altered.

GRASSLAND HABITATS

Foothill and Mountain Grasslands

Foothill and mountain grasslands support 48 SGCN (Table 8). This habitat type includes three non-shortgrass prairie grassland types: Western Great Plains Foothill and Piedmont Grassland, Southern Rocky Mountain Montane-Subalpine Grassland, and Inter-Mountain Basins Semi-Desert Grassland. Together these grasslands cover about three million acres in Colorado.

Foothill and piedmont grasslands are found at the extreme western edge of the Great Plains, where increasing elevation and precipitation facilitate the development of mixed to tallgrass associations on certain soils. These grasslands typically occur at elevations between 5,250 and 7,200 feet. Typical species include big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), needle-and-thread (*Hesperostipa comata*), and prairie sandreed (*Calamovilfa longifolia*).

Montane-subalpine grasslands in the Colorado Rockies are found at elevations of 7,200-10,000 feet, intermixed with stands of spruce-fir (*Picea engelmannii*-*Abies lasiocarpa*), lodgepole pine

(*Pinus contorta*), ponderosa pine (*Pinus ponderosa*), and aspen (*Populus tremuloides*), or as the matrix community (e.g., in the large intermountain basin of South Park). Typical dominant grass species include fescue (*Festuca* spp.), muhly (*Muhlenbergia* spp.), oatgrass (*Danthonia* spp.), and others. Lower elevation montane grasslands are more xeric, while upper montane or subalpine grasslands are more mesic. Grasses of the foothills and piedmont may be included in lower elevation occurrences. Trees and shrubs are generally sparse or absent, but occasional individuals from the surrounding communities may occur.

Colorado's semi-desert grasslands are found primarily on dry plains and mesas of the western slope at elevations of 4,750-7,600 feet. These grasslands are typically dominated by drought-resistant perennial bunch grasses such as bluebunch wheatgrass (*Pseudoroegneria spicata*), blue grama (*Bouteloua gracilis*), galleta grass (*Pleuraphis jamesii*), and needle-and-thread (*Hesperostipa comata*), and may include scattered shrubs.

A significant portion of historic occurrences of lower elevation foothill and piedmont grasslands on the eastern slope have been lost through conversion to cropland and commercial and residential development. Some remaining patches are in fair condition, but others – especially along Colorado's Front Range – are highly fragmented and invaded by cheatgrass (*Bromus tectorum*), leafy spurge (*Euphorbia esula*), Dalmatian toadflax (*Linaria dalmatica*), Canada thistle (*Cirsium arvense*), and other exotic species. Current impacts from human activity other than domestic livestock grazing are low in the montane grasslands; condition of these grasslands is generally good to excellent. Low elevation grasslands on the western slope are generally fair, but are poor in some areas where native grasses have been replaced by invasive species such as cheatgrass.

Mixed and Tallgrass Prairies

Mixed-grass and tallgrass prairies support 37 SGCN (Table 8). Mixed-grass habitats are characterized by mid-height or tall native grasses including sideoats grama (*Bouteloua curtipendula*), little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), needle-and-thread (*Hesperostipa comata*). Tallgrass is characterized by the dominance of big bluestem. Due to its position on the periphery of the range of the mixed-grass prairie, Colorado has probably never supported extensive tracts of these types. Habitats characterized by mid- to tall-grass species are limited in Colorado, and most commonly occur as small patches interspersed among shortgrass prairie and sandsage, or in mesic areas near the foothills. The eastern plains mixed-grass remnants are generally in degraded condition, lacking the diversity and extent of mid- to tallgrass species that would have historically been present. Historically, foothills valleys and swales (now frequently filled with reservoirs or houses) would have supported tallgrass communities in Colorado. Now tallgrass prairie only occurs in small, scattered patches where moist soils are present, such as upland terraces above floodplains. Fire,

grazing, and drought are the primary ecological processes. The diversity within this habitat likely reflects both the short- and long-term responses of the vegetation to these often concurrent disturbance regimes. Fire suppression and overgrazing can lead to the invasion by woody species such as juniper and ponderosa pine. Conversion to agriculture likewise has probably decreased the range of these habitats within the state. Ongoing wind energy development may have some impact.

Shortgrass Prairie

Shortgrass prairie supports 52 SGCN (Table 8). Shortgrass prairie, characterized by blue grama (*Bouteloua gracilis*), buffalo grass (*Bouteloua dactyloides*), and other short to mid-height species, once covered most of Colorado east of the mountain front, at elevations below 6,000 feet. Today, nearly 50% of our historic shortgrass prairie has been converted to row crop agriculture or other uses – the largest loss of any of Colorado's habitats. Remaining tracts have often been managed for domination of blue grama and exclusion of other grasses, with a consequent loss of native forb diversity. In the early 1800s, the shortgrass prairie was home to massive herds of free-ranging bison and pronghorn, as well as huge prairie dog colonies, deer, elk, and top predators such as the gray wolf and grizzly bear. Pronghorn and prairie dogs still inhabit Colorado's prairies in reduced numbers, and the former top predators have been replaced by coyotes.

Large-scale ecological processes such as drought, fire, and grazing by large animals exert strong influences on shortgrass. The short grass species that dominate this ecological system are tolerant of drought and grazing. Ongoing impacts include renewable and non-renewable energy production (wind, solar, geothermal, oil and gas, and biofuels) and continuing expansion of urban and exurban communities, especially along the Front Range. The continued presence of shortgrass prairie in our state may also be threatened by changing climate. Preliminary results from our climate change vulnerability assessment indicate that shortgrass prairie is highly vulnerable. Soil moisture is a key driver for this habitat; change in precipitation seasonality, amount, or pattern will affect soil moisture. Although these grasslands are adapted to warm, dry conditions, increasing warmer and drier conditions are likely to favor increasing growth of shrubby species (e.g., cholla [*Cylindropuntia imbricata*], snakeweed [*Gutierrezia sarothrae*]), especially in areas that are disturbed.

RIPARIAN AND WETLAND HABITATS

Playas

Playas support 16 SGCN (Table 8). Playas are shallow, temporary wetlands that occur throughout the shortgrass prairie on Colorado's eastern plains, as well as in limited distribution

on the western slope. They are ephemeral in nature, filling with water only after heavy rainfall. As would be expected of wet habitats in a dry environment, playas are very important habitat components for many species that inhabit or migrate through Colorado. Playas are threatened by conversion of surrounding native habitat to urban and/or agricultural uses, as well as indirect effects of such development (for example, road construction, sedimentation, pollution and runoff, deliberate filling). The current condition of playas is variable, but is generally fair to poor.

Riparian Woodlands and Shrublands

Riparian woodlands and shrublands support 26 SGCN (Table 8). Riparian woodlands and shrublands occur throughout Colorado. At montane to subalpine elevations, riparian shrublands may occur as narrow bands of shrubs lining streambanks and alluvial terraces, or as extensive willow carrs in broad floodplains and subalpine valleys. They can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Dominant shrubs within this elevation zone include alder (*Alnus tenuifolia*), birch (*Betula occidentalis*), dogwood (*Cornus sericea*), and willow (*Salix*) species. Generally the upland communities surrounding these riparian systems are either conifer or aspen forests. Many higher elevation riparian shrublands are associated with beaver (*Castor canadensis*) activity, which can be important for maintaining the health of the riparian ecosystem (historically this would have been true for lower elevation streams as well). Beaver dams abate channel down cutting, bank erosion, and downstream movement of sediment. They also raise the water table across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment.

Montane to subalpine riparian woodlands are comprised of seasonally flooded forests and woodlands throughout the Rocky Mountains. They include the conifer and aspen woodlands that line montane streams. They are most often confined to specific riparian environments, occurring on floodplains or terraces of rivers and streams or in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, high elevation riparian woodlands are found in moderate to wide valley bottoms, on large floodplains along broad, meandering rivers, and on pond or lake margins. Riparian woodlands are tolerant of periodic flooding and high water tables. Snowmelt moisture in this system may create shallow water tables or seeps for a portion of the growing season.

At lower elevations on the western slope, riparian woodlands and shrublands are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. They often occur as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. Forests are typically dominated by cottonwood (*Populus angustifolia*, *P. deltoides*) and willow (*Salix* spp.), but may include maple (*Acer glabrum*), Douglas fir (*Pseudotsuga*

menziesii), spruce (*Picea* spp.), and juniper (*Juniperus* spp.). Shrublands are primarily dominated by willow, alder, and birch. Lower elevation riparian woodlands and shrublands are dependent on a natural hydrologic regime, especially annual to episodic flooding. These woodlands and shrublands grow within a continually changing alluvial environment due to the ebb and flow of the river, and riparian vegetation is constantly being “re-set” by flooding disturbance. In some areas, Russian olive (*Elaeagnus angustifolia*), tamarisk (*Tamarix* spp.), and other exotic species are common.

On the eastern plains, riparian woodlands and shrublands are generally dominated by plains cottonwood (*Populus deltoides*) and willow species, but also occur as a mosaic of multiple communities interspersed with herbaceous patches. They are found along small, medium and large streams on the plains, including the wide floodplains of the South Platte and Arkansas Rivers. Hydrologically, smaller rivers tend to have greater seasonal variation in water levels with less developed floodplain than the larger rivers, and can dry down completely for some portion of the year. Plains riparian areas are often subjected to heavy grazing and/or agriculture and can be heavily degraded. Tamarisk and less desirable grasses and forbs have invaded degraded examples throughout eastern Colorado. Groundwater depletion and lack of fire have created additional species changes.

Riparian woodlands and shrublands at higher elevations are in good to excellent condition. At lower elevations, however, conditions are only fair overall and can be poor in areas subjected to intense grazing, agricultural use, urban development, and/or hydrological alteration. Many of these communities have degraded understories, with weedy herbaceous layers and Russian olive and tamarisk invading the shrub layers. Cottonwood die-offs related to prolonged, intense drought and hydrological alterations have affected some stands.

Wetlands

Non-riparian wetlands support 53 SGCN (Table 8). In Colorado, non-riparian wetland habitats include moist to wet meadows, emergent marshes, fens, and seeps and springs.

Meadows occur throughout Colorado, but most natural wet meadows are found within the montane to subalpine zone. Natural wet meadows are tightly associated with snowmelt or subsurface groundwater discharge, and are typically not subjected to high disturbance events such as flooding. Within mountain valleys and at lower elevations, extensive acres of wet meadows are also linked to irrigation practices, including flood irrigation and seepage from irrigation ditches. Natural wet meadows are dominated by native sedges and grasses, while those influenced by irrigation may be dominated by non-native pasture grasses.

Emergent marshes are wetlands that experience frequent or prolonged ponding. Marshes occur in depressions and kettle ponds, as fringes around lakes, along streams and rivers, and behind many types of impoundments. They can be found at all elevations, but are more common at mid to lower elevations. Standing water restricts the dominant species to robust wetland plants, such as cattail (*Typha*), bulrush (*Scirpus* and *Schoenoplectus* spp.), and large sedges (*Carex* spp.). At lower elevations, marshes can become densely vegetated if they are not periodically flushed by floodwater or mechanical thinning.

Fens are wetlands with thick organic soils that are supported by stable groundwater discharge. Fens are typically found within the montane to subalpine zone, generally above 7,000 feet, and can form along the edges of valley bottoms, at breaks in slope, around hillslope seeps, in shallow basins or anywhere where sufficient ground water emerges to perennially saturate soils. Fens are considered “old growth” wetlands, as the accumulation of thick organic soils can take thousands of years. Fen vegetation is generally characterized by a dense cover of sedges and moss, often intermixed with forbs and short to dwarf shrubs such as willow and bog birch (*Betula nana*).

Seeps and springs include small wetlands that are hydrologically supported by groundwater discharge. They are found throughout Colorado and can be a component of the previously described wetland types, but are most notable within the cliff and canyon country of the Colorado Plateau and the Lower Arkansas River basin.

Montane to subalpine wetlands are generally in good condition, though many acres are impacted by water diversions, groundwater pumping, and grazing of both domestic and wild animals. The condition of lower elevation wetlands, however, is far worse. Non-native species, including noxious weeds, are prevalent and may dominant many wetlands. Intensive water management and human development have greatly altered the timing and magnitude of flooding. In some locations, water has been diverted from natural wetlands. In others, storm water runoff and irrigation return flows have created or expanded wetland acres, but these systems experience flashy hydroperiods and degraded water quality.

AQUATIC HABITATS

Colorado Plateau - Wyoming Basins Rivers

Colorado Plateau – Wyoming Basins rivers support 31 SGCN (Table 8). This habitat includes the big rivers within the Colorado Plateau and Wyoming Basin ecoregions of Colorado's western slope: the Colorado, Gunnison, Green, Yampa, White, Dolores, San Juan and Animas Rivers. Larger-order rivers contain habitat features that are unavailable in smaller streams, particularly deep pools and runs, and large backwaters and inundated floodplain areas during high water. As

a result, they comprise the core habitat for several big-river fish species, though these species are also occasionally found in smaller streams. Condition of this habitat type varies, but is moderately or highly impacted for most of these rivers. Dams and diversions have altered the natural hydrograph to varying degrees. In most of these rivers, snowmelt-driven peak flows are greatly reduced, as are base flows in many cases. Peak flow timing may be altered such that these flows no longer coincide with the life-history requirements of big river fish species. Extensive flow management efforts are being made to redress that situation in some rivers. Additionally, dams and diversion structures function as barriers preventing upstream movement of fishes (though fish passage structures have been constructed at some). A number of these species are highly migratory and require many miles of unfragmented habitat in order to move between spawning and rearing, foraging, and overwintering areas. These changes, combined with channelization and bank hardening, impacts from energy development, bank stabilization by non-native vegetation (tamarisk, Russian olive), and other anthropogenic stressors, have degraded the condition of associated riparian habitats as well.

Colorado Plateau – Wyoming Basins Streams

Colorado Plateau – Wyoming Basins streams support 27 SGCN (Table 8). This habitat includes tributaries to the big river systems within the Colorado Plateau and Wyoming Basins ecoregions of Colorado's western slope. Condition varies widely, with some streams in excellent condition, but the majority of streams are moderately or severely impacted. Dams and, especially, diversions have altered the natural hydrograph and fragmented habitat, to the extent of entirely dewatering some stream reaches. Other anthropogenic impacts include gravel mining and grazing within the riparian corridor, channelization and bank hardening, impacts from energy development, and encroachment of non-native vegetation (tamarisk, Russian olive), all of which have the potential to degrade water quality and the condition of associated riparian habitats.

Eastern Plains Rivers

Eastern Plains rivers support 33 SGCN (Table 8). This habitat includes the mainstems of the South Platte and Arkansas Rivers, and the lower portions of major tributaries such as the Cache la Poudre River and St. Vrain Creek. These larger-order rivers contain habitat features generally not found in smaller plains streams, including occasional deep pools, secondary channels and backwaters, and inundated floodplain areas during high water. As a result, they comprise the core habitat for several plains fishes, though these species are also sometimes found in smaller tributaries. Condition is heavily impacted in terms of both water quality and water quantity. Dams and numerous large diversions have greatly altered the timing and magnitude of both peak and base flows, as well as other components of the natural hydrograph. In many reaches, treated municipal waste water and/or irrigation return flows maintain base flows at higher levels than

pre-alteration. A plethora of stressors from extensive urban and exurban development, and from agriculture, degrade both water quality and the condition of associated riparian habitats.

Eastern Plains Streams

Eastern Plains streams provide primary habitat for 44 SGCN (Table 8). This habitat includes the tributaries to the big rivers of Colorado's eastern plains, and the Republican River and its tributaries. Most of these streams rise on the plains and thus have a hydrograph and temperature regime distinct from streams originating in the mountains. Streams in this region are of a diverse character. Many rise from springs and flow consistently in headwaters areas but subside into intermittency further downstream, only becoming more perennial again when they reach the alluvium of the mainstem. The more intermittent portions of these systems only fully connect during flood events, and at other times consist partly or entirely of isolated pools within a dry channel. Some plains fishes appear to be specifically adapted to this hydrologic regime, preferring or requiring standing-water, pond-like habitat, and utilizing periods of connectivity to redistribute and re-colonize habitat patches. A number of such naturally-occurring pools have been impounded, enlarged or otherwise made into more permanent ponds or small lakes, for stock watering or other human uses. These areas, though modified, comprise some of the most important habitat for several plains fish species, especially northern redbelly dace, and also plains topminnow, southern redbelly dace, and Arkansas darter. Streams in the Republican basin tend to be more historically perennial, as are a few larger tributaries such as the Purgatoire and St. Charles Rivers. Diversions and habitat degradation threaten all these streams to varying degrees. A more pressing threat throughout most of the region is drying and fragmentation due to groundwater irrigation depleting underlying aquifers. This threat is particularly dire in the Republican Basin, but is imminent throughout the Eastern plains.

Lakes

Lakes support 25 SGCN (Table 8). This habitat type includes only natural lakes, the majority of which occur in the subalpine and montane zones. Very few lower-elevation natural lakes exist within Colorado; most of these are oxbow lakes, former river channels that became isolated, and are quite small. Because this habitat type occurs mostly at high elevations where human impacts and natural disturbances are limited, its condition is generally excellent.

Mountain Streams

Mountain streams support 30 SGCN (Table 8). Mountain stream habitat includes high elevation streams on both sides of the Continental Divide. These streams are characterized by high gradient, cold temperatures, and a snowmelt-dominated hydrograph. Though few waterways in

Colorado have escaped some level of disturbance, mountain streams remain in good condition overall.

Rio Grande Valley Rivers

Rio Grande Valley rivers are primary habitat for two Tier 1 SGCN (Table 8). This habitat consists of the mainstem Rio Grande and the Conejos River. The high elevation and distinct climate of this watershed differentiate it from other east slope drainages. Within the watershed, these larger-order rivers contain habitat features infrequently found in the tributaries, particularly deep pools and runs. Historically the Rio Grande and Conejos are known or believed to have been primary habitat for several endemic species. Native fish populations have been lost because of water diversions for irrigation, stream drying, and habitat degradation. Additionally, competition, predation, and hybridization by nonnative fish have contributed to extirpation of native fish populations in the Rio Grande and Conejos.

Rio Grande Valley Streams

Rio Grande Valley streams are primary habitat for two Tier 1 SGCN (Table 8). This habitat includes the tributaries to the Rio Grande, the Conejos River, and the closed-basin streams of Saguache Creek and San Luis Creek. Condition of these streams varies, but most have low to moderate levels of impact. Diversions, mainly for agricultural use, have altered the natural hydrograph and fragmented streams to varying degrees, in some cases entirely dewatering stream reaches. The closed-basin streams remain less disturbed, although some are threatened by drying of the aquifer.

Transition Zone Streams

Transition zone streams support 33 SGCN (Table 8). The abrupt transition from mountains to plains along the Front Range and east slope give rise to this habitat. At this juncture streams rapidly lose gradient, increase in sinuosity and acquire other characteristics of plains streams, but continue to have a snowmelt-driven hydrograph, colder temperatures and coarser cobble-gravel substrate, reflective of their origin in the mountains, for some distance downstream. These relatively short reaches of intermediate character comprise the sole habitat within Colorado for several “glacial relict” SGCN—species adapted to lower-gradient waters that are cooler than most Colorado plains streams—which are believed to have been “stranded” in this zone as glaciers receded. Because most Front Range cities were established along rivers at the base of the mountains, the transition zone is heavily impacted by many effects of urban development, and is among the most imperiled of aquatic habitats in Colorado. Additionally, it is likely especially vulnerable to climate change, with the prospect of species being “pinched” between warmer water downstream and unfavorable gradient upstream.

OTHER HABITATS

Alpine

Alpine habitats, which cover over 1.5 million acres in Colorado, support 32 SGCN (Table 8). Alpine includes high-elevation dry tundra, fellfield, wet-meadow, and rock and scree communities. Alpine tundra is found at the highest elevations in our state, usually above 11,000 feet. Here the long winters, abundant snowfall, high winds, and short summers create an environment too harsh for permanent human habitation. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season.

Old privately-owned mining claims are scattered throughout, but there are very few active mines operating today. In general, alpine tundra in Colorado is currently in excellent condition. The primary threat to this ecological system is global climate change, which could have significant impacts in the future. Preliminary results from our climate change vulnerability assessment suggest that alpine habitats are moderately vulnerable through mid-century. Snowpack patterns are important for this habitat. Thus, if Colorado experiences an increase in winter precipitation, alpine areas may be able to withstand some increase in temperature, at least in the short term, and especially in areas where it is difficult for trees to advance. At a longer time frame, however, alpine is likely to largely disappear from Colorado.

Cliffs and Canyons

Cliffs and canyons support 34 SGCN (Table 8). Mountain cliffs and canyons habitats are found from foothill to subalpine elevations. They include barren and sparsely vegetated landscapes comprised of steep cliff faces, narrow canyons, and open tablelands, as well as the unstable scree and talus slopes that typically occur below cliff faces. Widely scattered trees and shrubs may be present. These highly erodible areas are generally too steep to allow any significant soil development. Erosion by wind, water, and the force of gravity is the primary natural disturbance process in the cliff environment. Cliffs and canyons have a naturally high rate of erosion; infiltration rates are low and runoff high. At cliff faces there is less hydraulic pressure retaining water within the rock, so liquid water is more consistently found than in the surrounding habitat types (Larson et al. 2000). Within the larger cliff habitat, steep slopes, small terraces ledges, overhangs, cracks and crevices often form a mosaic of microhabitat types that appears to be the primary factor contributing to cliff biodiversity (Graham and Knight 2004). Cliffs and bedrock outcrops are relatively free of anthropogenic disturbance, but the canyons where these often occur are rarely without roads. Human disturbance to this system may include road construction and maintenance, recreation (especially climbing), and the effects of mining.

On the eastern plains, this habitat type includes cliffs, outcrops, breaks and barrens, rimrock and erosional remnants of the High Plains escarpment, as well as other isolated buttes and outcrops to the south. Drought and wind erosion are the most common natural dynamics affecting this prairie system. Wind energy development is increasing on prairie cliff/canyon habitats, but in general, condition of cliff and canyon habitats is good. Many cliff and canyon habitats are virtually inaccessible and in excellent condition.

Hot Springs

Hot Springs are the primary habitat for one Tier 2 SGCN (Table 8). These habitats are limited to physical settings that allow groundwater heated by geothermal processes to rise to the surface. Many of Colorado's hot springs have been developed for human recreation. Presumably this has had deleterious effects on habitat quality, but detailed condition of Colorado's hot springs has not been evaluated.

Reservoirs and Shorelines

This habitat, though man-made, is significant for 10 of Colorado's Tier 2 SGCN (Table 8), most notably the federally listed Least tern and Piping plover. Reservoir and shoreline habitat is distributed across Colorado. The largest and most important from a habitat perspective include John Martin and other reservoirs in southeastern Colorado. The future of reservoir and shoreline habitats in Colorado is difficult to predict. It seems reasonable to assume that under a warming and drying climate scenario (the likeliest future for the eastern plains), water resources will become scarcer. This situation could potentially change the management of dams and reservoirs. If water levels recede, the amount of plover or tern nesting habitat varies with the topographic contours of the reservoir. Some might gain more isolated islands with lower water, while the opposite may also be true (more dry areas connected to shoreline). Depending on how and when such changes were made, impacts to SGCN are possible but currently unknown.

Sand Dunes

Sand dunes are a primary habitat for four SGCN (Table 8). In Colorado, small sand dunes habitats occur in North Park and Middle Park, but the majority of sand dunes habitat occurs in the San Luis Valley. These environments are comprised of shifting, coarse-textured substrates and patchy or open grasslands or shrublands. Active and stabilized dune areas include a range of sparsely vegetated plant communities as well as barren or near barren (<5% total plant cover) portions of active sand dunes and sandsheet blowouts, where scattered individuals of early seral species such as blowout grass (*Redfieldia flexuosa*) and lemon scurfpea (*Psoralidium lanceolatum*), and (rarely) Indian ricegrass (*Achnatherum hymenoides*), are the only vegetation. The sandsheet may also include limited areas with woodlands of narrowleaf cottonwood or

ponderosa pine on otherwise sandy areas, as well as both shrubby and grassy areas where vegetation is acting to anchor dunes. Shrub dominated plant communities of the sandsheet are shrub steppe or shrublands dominated by rabbitbrush and other shrubs with a typically sparse herbaceous layer dominated by bunchgrasses. In early seral stages, vegetated dunes and sandsheet areas where shrubs are absent may be characterized by an herbaceous layer typically dominated by scurfpea and/or blowout grass, while in late seral stages Indian ricegrass, needle-and-thread or sand muhly (*Muhlenbergia arenicola*) are typical. The condition of most sand dune habitats in Colorado is very good, with the exception of those in North Park, where the dunes are impacted by recreational vehicle use and weeds.

Agriculture

For the purposes of the SWAP, this habitat type is restricted to no-till and conventional till agriculture in both irrigated and dryland (non-irrigated) situations, including croplands and orchards. Though rangelands are an important component of our state's agricultural system, native rangelands are included under relevant grassland and shrubland habitat types and omitted from this section. Agricultural fields constitute a man-made environment, but they now serve as important habitat for 39 SGCN (Table 8).

The major cropping regimes in Colorado can be broken into three regions: the Eastern Plains, the northwest, and the southwest. Crops on the Eastern Plains include irrigated and dryland situations where the major crops are wheat, corn, millet, milo, and alfalfa. Some of these cropping systems will include a fallow year. Aside from tall grasses, growing wheat provides some of the most available nesting cover on the Eastern Plains for ground nesting birds, including northern bobwhite. Additionally, CPW has recently documented successful nesting of lesser prairie-chickens in growing wheat via GPS transmitters. Corn, millet, and milo provide loafing and foraging cover for a wide suite of wildlife, and can also provide good winter cover if adequate stubble heights are left after harvest. The fallow period in some cropped or the non-cropped portion of the year can provide habitat components for low structure and bare-ground associated species like mountain plover and burrowing owl. CPW research on mountain plover has documented significant use and successful nesting on fallow agricultural fields.

Northwest region crops consist mainly of irrigated grass hay, wheat, and alfalfa. Irrigated grass hay and alfalfa fields can provide a variety of wildlife cover, but are especially important brood-rearing cover for greater sandhill cranes and greater sage grouse. Wheat fields in the northwest provide much of the same cover as those on the Eastern Plains and are especially important for Columbian sharp-tailed grouse. Irrigated hayfields and meadows also mimic native wet meadows and provide substantial benefits to SGCN using that habitat type, particularly in the three significant mountain parks (North Park, Middle Park, and South Park). Again, the fallow

cover that is left as part of the cropping rotations provides nesting, brood-rearing, and foraging cover for wildlife.

Southwest region crops consist primarily of irrigated alfalfa, grown for seed and hay, and barley, with relatively smaller amounts of sunflower, corn and potato. Each of these crops provide some cover for wildlife during the growing season, but generally these crops do not provide much winter cover due to harvesting and other treatments that reduce stubble heights and residual cover. A significant percentage of crops grown within the southwest region are dependent on irrigation; there are not many acres of tilled ground in this region.

Conservation Reserve Program

The Conservation Reserve Program (CRP) is a federal program executed by the U.S. Department of Agriculture's Farm Service Agency. The program pays landowners to retire cropland for 10 to 15 years at a time to address soil erosion, water quality and wildlife habitat concerns. The retired fields are planted to a perennial cover of grasses, forbs and/or shrubs. These lands, which frequently provide critical wildlife cover and are often in areas where production cropland is the primary land use, support 26 SGCN. CRP lands are important for sustaining populations of Gunnison sage grouse, plains and Columbian sharp-tailed grouse, lesser and greater prairie-chickens, and a suite of grassland nesting birds as well as many other species. Currently, Colorado has approximately 1.8 million acres of land enrolled in the CRP, down from a high of 2.2 million. Most CRP lands are in eastern Colorado, east of Interstate 25, but pockets of CRP west of the Continental Divide also support locally and regionally important wildlife populations such as the Dove Creek population of Gunnison sage-grouse, Columbian sharp-tailed grouse in Routt County, and an experimental transplant population of Columbian sharp-tailed grouse in Dolores and Montezuma counties.

Many CRP lands were planted in the late 1980s during the first program sign-up. Because of their age and low diversity seed mixes focusing only on soil erosion during the early sign-up periods, Colorado's CRP fields generally lack plant species and structural diversity, and often may be monotypic stands of smooth brome, sideoats grama, or crested wheatgrass. Thus, most of the state's fields would benefit from management efforts designed to enhance plant diversity and increase wildlife habitat benefits.

Chapter 4: Threats and Conservation

Actions Overview

This chapter presents updated information on the problems affecting Colorado's Species of Greatest Conservation Need (SGCN) and their habitats, as well as conservation actions needed to address problems and improve species' status. Current information on problems that may adversely affect SGCN or their habitats (i.e., "threats") was compiled from a number of different sources, including the 2006 SWAP, agency and partner biologists, and a variety of existing conservation assessments, conservation and management plans, CPW and CNHP databases, and published literature. There are myriad existing resources that present in-depth discussions of threats and/or needed conservation actions for many of the SGCN and their habitats. The purpose of the SWAP is not to re-create these resources. Rather, in this document we will summarize the most crucial aspects of biodiversity conservation in Colorado over the next 10 years. A list of additional resources, including management, conservation, and recovery plans, is presented in Appendix D.

This threat assessment was undertaken strictly from the perspective of wildlife conservation. Some of the identified practices are also necessary and highly valued public services and land uses – for instance, water development, residential development, recreation, mining, and agriculture. These activities provide important values and are legitimate, often vital public pursuits, from which all of society benefits. Nonetheless, aspects of some of these activities are sometimes harmful to wildlife and their habitats, which are also legitimate public values and resources; therefore, these actions pose challenges from the viewpoint of wildlife conservation. These challenges need to be identified in order to determine which are most harmful, and importantly, where opportunities for investments in remedial or preventive actions would be most effective and efficient.

Updated Lexicon for Describing Threats & Actions

As noted in the 2006 SWAP, many sources use different language to describe essentially the same threats and conservation actions. In order to maintain consistency of threats/actions descriptions across species and habitats, "taxonomies" of threats and actions were created for the 2006 SWAP, based on work by The Nature Conservancy. In the interim, a standardized lexicon has been developed by the Conservation Measures Partnership⁷ (Salafsky et al. 2008), and is

⁷ The Conservation Measures Partnership (CMP) is a joint venture of conservation organizations and collaborators that are committed to improving the practice of conservation. Each organization within CMP has biodiversity conservation as its primary goal, has a focus on field-

recommended in the 2012 Best Practices for State Wildlife Action Plans guidance (AFWA 2012). For the 2015 SWAP, we have adopted the Salafsky lexicon's classification of general threats and conservation actions (Tables 5 & 6, respectively). The database that was developed to house information on SGCN and habitats for the 2006 SWAP has been updated to reflect the new lexicon. Use of the Salafsky lexicon will position the CPW to migrate SGCN information and conservation work planning to the Miradi program, a tool also developed by the Conservation Measures Partnership, in the future if it is determined that we can improve our conservation outcomes by doing so.

The Salafsky lexicon uses a three-level categorization scheme, with each level increasingly specific (Tables 5 & 6). As explained in Salafsky et al. (2008),

*“An ideal classification for both threats and actions would be **simple** (uses clear language and examples and is understandable by all practitioners); **hierarchical** (creates a logical way of grouping items that are related to one another to facilitate use of the classification and meaningful analyses at different levels); **comprehensive** (contains all possible items, at least at higher levels of the hierarchy; consistent (ensures that entries at a given level of the classification are of the same type); **expandable** (enables new items to be added to the classification if they are discovered); **exclusive** (allows any given item to only be placed in one cell within the hierarchy); and **scalable** (permits the same terms to be used at all geographic scales)...The classifications are designed to be comprehensive, consistent, and exclusive for the first and second levels. The third level, by contrast, is at a much finer scale and thus only contains some illustrative examples rather than comprehensive listings of threats and actions at this level.”*

An example of the three-level classification is:

Level 1 – Human Intrusions and Disturbance

Level 2 – Recreational Activities

Level 3 – hiking

Using this lexicon will allow for large-scale analyses (e.g., allowing federal agencies and national non-governmental organizations to assess threats across states), but it must also provide enough specificity to direct meaningful conservation action in Colorado. Thus, we have modified it to include additional Level 1 and Level 2 categories that were deemed necessary to adequately describe the situation in Colorado, and added more detailed entries in Level 3.

As with any classification method, there are various ways to categorize and “lump or split,” and all options ultimately force some degree of simplification onto very complex and inter-related issues. The Salafsky lexicon is no exception, and readers may experience a degree of discomfort with some applications of this method. We remind those readers that the SWAP is a statewide, strategic document that is intended to highlight the most significant conservation issues across

based conservation actions, and is working to develop better approaches to project design, management, and assessment. For additional information, visit <http://www.conservationmeasures.org/>.

our state. As such, it is a first step in conservation planning that is appropriately supported by a series of more in-depth species and habitat conservation plans. Existing and needed species/habitat plans are addressed in the tables and narratives that follow.

Table 5. Lexicon of threats according to Salafsky et al. 2008.

Threats marked with an asterisk (*) are not included in Salafsky et al. (2008), but we have determined that they are needed to fully express threats to SGCN in Colorado.

Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
1 Residential & Commercial Development Threats from human settlements or other non-agricultural land uses with a substantial footprint	1.1 Housing & Urban Areas Human cities, towns, and settlements including non-housing development typically integrated with housing (e.g., shopping areas, offices, schools, hospitals)	<ul style="list-style-type: none"> • Housing, urban, and ex-urban development • Hobby livestock – domestic sheep and goats associated with exurban development
	1.2 Commercial & Industrial Areas Factories and other commercial centers (e.g., manufacturing plants, military bases, power plants, train yards, airports)	
	1.3 Tourism & Recreation Areas Tourism and recreation sites with a substantial footprint (e.g., ski areas, golf courses, county parks, campgrounds)	<ul style="list-style-type: none"> • Recreation area developments
2 Incompatible Agriculture⁸ Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture and aquaculture	2.1 Annual & Perennial Non-Timber Crops Crops planted for food, fodder, fiber, fuel, or other uses (e.g., farms, plantations, orchards, vineyards, mixed agroforestry systems)	<ul style="list-style-type: none"> • Conversion to cropland • Early/often pasture and hayfield cutting (nest destruction) • Intensive agricultural operations • Loss of compatible CRP lands • Poor quality CRP lands
	2.2 Wood & Pulp Plantations Stands of trees planted for timber or fiber outside of natural forests, often with non-native species (e.g., silviculture, Christmas tree farms)	

⁸ In Salafsky et al. (2008), this threat is “Agriculture and Aquaculture.” For the purposes of this SWAP, we have changed this threat to “Incompatible Agriculture,” in recognition of the role that some agricultural lands play in providing wildlife habitat.

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Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
	<p>2.3 Livestock Farming & Ranching Domestic terrestrial animals raised in one location on farmed or non-local resources (farming); also domestic or semi-domesticated animals allowed to roam in the wild and supported by natural habitats (ranching) (e.g., cattle feed lots, dairy farms, cattle ranching, chicken farms)</p>	<ul style="list-style-type: none"> • Altered native vegetation • Decreased water quality (nutrient load from cattle) • Degradation of alpine habitats from sheep grazing & disturbance by guard dogs • Incompatible timing, intensity, duration of grazing • Range improvement operations • Reduced grass and forb diversity • Transmission of pathogens
	<p>2.4 Marine & Freshwater Aquaculture Aquatic animals raised in one location on farmed or non-local resources; also hatchery fish allowed to roam in the wild</p>	
<p>3 Energy Production & Mining Threats from production of non-biological resources</p>	<p>3.1 Oil & Gas Drilling Exploring for, developing, and producing petroleum and other liquid hydrocarbons (e.g., oil wells, natural gas drilling)</p>	<ul style="list-style-type: none"> • Altered native vegetation • Behavioral avoidance of oil/gas development & associated infrastructure • Fragmentation of native habitat due to oil/gas development & associated infrastructure
	<p>3.2 Mining & Quarrying Exploring for, developing, and producing minerals and rocks (e.g., coal mines, alluvial gold panning, gold mines, rock quarries)</p>	<ul style="list-style-type: none"> • Mining operations • Rock mining in nesting & winter habitat • Uranium mining
	<p>3.3 Renewable Energy Exploring, developing, and producing renewable energy (e.g., geothermal power production, solar farms, wind farms, birds flying into windmills)</p>	<ul style="list-style-type: none"> • Collision with wind turbines • Behavioral avoidance of renewable energy development & associated infrastructure • Fragmentation of native habitat due to renewable energy development & associated infrastructure
<p>4 Transportation & Service Corridors Threats from long narrow transport corridors and the vehicles that use them, including associated wildlife mortality</p>	<p>4.1 Roads & Railroads Surface transport on roadways and dedicated tracks (e.g., highways, secondary roads, logging roads, bridges and causeways, road kill, fencing associated with roads)</p>	<ul style="list-style-type: none"> • Collision (e.g., auto) • Fragmentation
	<p>4.2 Utility & Service Lines Transport of energy & resources (e.g., electrical and phone wires, oil and gas pipelines, electrocution of wildlife)</p>	<ul style="list-style-type: none"> • Collision (e.g., powerlines)

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Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
	4.3 Shipping Lanes (<i>not applicable to Colorado</i>)	
	4.4 Flight Paths (e.g., impacting birds)	<ul style="list-style-type: none"> • Low-flying military jets & helicopters
5 Biological Resource Use Threats from consumptive use of “wild” biological resources including both deliberate and unintentional harvesting effects; also persecution or control of specific species	5.1 Control of Nuisance Species or Collecting⁹ Killing or trapping wild animals for commercial, recreation, subsistence, research or cultural purposes, or for control/persecution reasons	<ul style="list-style-type: none"> • Extermination / evictions in urban settings • Loss of habitat due to prairie dog control • Mortality and prey reduction through rodent control • Poisoning (indirect effect of prairie dog control)
	5.2 Gathering Terrestrial Plants Harvesting plants, fungi, and other non-timber/non-animal products for commercial, recreation, subsistence, research or cultural purposes, or for control reasons	
	5.3 Logging & Wood Harvesting Harvesting trees and other woody vegetation for timber, fiber, or fuel (e.g., clear cutting of hardwoods, pulp operations, fuel wood collection)	<ul style="list-style-type: none"> • Clearcutting • Even-age timber management • Removal of cavity trees • Fragmentation • Replacement of mature/old growth with younger, more even-aged stands
	5.4 Fishing & Harvesting Aquatic Resources Harvesting aquatic wild animals or plants for commercial, recreation, subsistence, research, or cultural purposes, or for control/persecution	
6 Human Intrusions & Disturbance Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources	6.1 Recreational Activities People spending time in nature or traveling in vehicles outside of established transport corridors, usually for recreational reasons (e.g., off-road vehicles, snowmobiles, mountain bikes, hikers, skiers, birdwatchers, pets in rec areas, temporary campsites, caving, rock-climbing)	<ul style="list-style-type: none"> • Campsites and hiking • ORV trail development and use • Motorized and non-motorized recreation • Recreational caving • Rock climbing, hiking near cliffs & crevices • Trails in drainages near nests • Unregulated backcountry winter recreation

⁹ In Salafsky et al. (2008), this threat is “Hunting and Collecting Terrestrial Animals.” Salafsky’s terminology is intended to address conservation needs at a global scale, including places where hunting is not managed. For the purposes of Colorado’s SWAP, the reference to hunting in this context was deemed to be misleading and inappropriate. Thus, we have re-named this threat category.

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Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
	<p>6.2 War, Civil Unrest & Military Exercises Actions by military forces without a permanent footprint (e.g., tanks and other military vehicles, training exercises and ranges, defoliation, munitions testing)</p>	
	<p>6.3 Work & Other Activities People spending time in or traveling in natural environments for reasons other than recreation, military activities, or research (e.g., law enforcement, drug smugglers, illegal immigrants, vandalism)</p>	<ul style="list-style-type: none"> • Proximal non-recreation disturbance
<p>7 Natural System Modifications Threats from actions that convert or degrade habitat in service of “managing” natural or semi-natural systems, often to improve human welfare</p>	<p>7.1 Fire & Fire Suppression Suppression or increase in fire frequency and/or intensity outside of its natural range of variation (e.g., fire suppression to protect homes, inappropriate fire management, escaped agricultural fires, arson, campfires)</p>	<ul style="list-style-type: none"> • Altered fire regime • Fire suppression leading to high intensity fires • Altered fire regime and juniper encroachment • Wildfires exacerbated by climate change
	<p>7.2 Dams & Water Management/Use Changing water flow patterns from their natural range of variation either deliberately or as a result of other activities (e.g., dam construction, dam operations, sediment control, change in salt regime, wetland filling, levees and dikes, surface water diversion, groundwater pumping, channelization, artificial lakes)</p>	<ul style="list-style-type: none"> • Altered hydrological regime – dewatering • Altered hydrological regime – siltation and sedimentation • Altered hydrological regime – wetland drainage • Altered hydrological regime – altered flow and fluctuating water temperatures • Decreased water quality and/or quantity • Natural system modification (hydrological) - dam, diversion, or drop structure construction or modification • Natural system modification (hydrological) – groundwater pumping and surface water diversions • River flow management and riverbank protection • Scouring floods • Water storage • Fragmentation due to diversion structures without fish passage

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Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
	<p>7.3 Other Ecosystem Modifications Other actions that convert or degrade habitat in service of “managing” natural systems to improve human welfare (e.g., land reclamation projects, abandonment of managed lands, rip-rap along shorelines, mowing grass, tree thinning in parks, beach construction, removal of snags from streams)</p>	<ul style="list-style-type: none"> • Altered animal community (change in predator/prey balance) • Altered animal community (loss of beaver) • Altered native vegetation (cottonwood/willow degradation) • Altered native vegetation (loss of older aspen stands) • Altered native vegetation (loss of shoreline nesting, roosting, and perching habitat) • Altered native vegetation (riparian area deforestation, denuding of wetland vegetation) • Altered native vegetation (seral stage imbalance) • Altered native vegetation (streambank cover reduction) • Cave/mine closures and grating • Fragmentation • Natural system modification - wetland filling, eutrophication, siltation
<p>8 Invasive & Other Problematic Species & Genes Threats from non-native and native plants, animals, pathogens /microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance</p>	<p>8.1 Invasive Non-Native/Alien Species Harmful plants, animals, and microbes not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities (e.g., feral cattle, household pets, zebra mussels)</p>	<ul style="list-style-type: none"> • Invasive animals - bullfrogs • Invasive animals - European starlings • Invasive animals - white sucker • Invasive animals – aquatic predators (e.g., smallmouth bass, northern pike, walleye, burbot) • Invasive plants – tamarisk • Invasive plants – cheatgrass
	<p>8.2 Problematic Native Species Harmful plants, animals, or microbes that are originally found within the ecosystem(s) in question, but have become "out-of-balance" or "released" directly or indirectly due to human activities (e.g., overabundant native deer)</p>	<ul style="list-style-type: none"> • Habitat loss / degradation due to beetle kill • Habitat loss due to insect damage and fire • Predation and parasites
	<p>8.3 Introduced Genetic Material Human altered or transported organisms or genes (e.g., pesticide resistant crops, using nonlocal seed stock, genetically modified insects for biocontrol)</p>	<ul style="list-style-type: none"> • Invasive animals - hybridization

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Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
	8.4 Pathogens ¹⁰	<ul style="list-style-type: none"> • Loss of prairie dog colonies due to sylvatic plague • Pathogen - canine distemper • Pathogen - chytrid fungus • Pathogen - respiratory disease caused by <i>Pasteurellacea</i> and <i>Mycoplasma</i> bacteria • Pathogen - sylvatic plague • Potential for white-nose syndrome to be introduced
9 Pollution Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources	9.1 Household Sewage & Urban Waste Water Water-borne sewage and non-point runoff from housing and urban areas that include nutrients, toxic chemicals and/or sediments (e.g., discharge from municipal waste treatment plants, leaking septic systems, fertilizers and pesticides from lawns and golf-courses)	<ul style="list-style-type: none"> • Water pollution
	9.2 Industrial & Military Effluents Water-borne pollutants from industrial and military sources including mining, energy production, and other resource extraction industries that include nutrients, toxic chemicals and/or sediments	<ul style="list-style-type: none"> • Waste or residual materials (excess sediment loads) • Waste or residual materials (mine tailings, excess sediment loads, etc.)
	9.3 Agricultural & Forestry Effluents Water-borne pollutants from agricultural, silvicultural, and aquaculture systems that include nutrients, toxic chemicals and/or sediments (e.g., nutrient loading from fertilizer runoff, herbicide runoff, manure from feedlots, soil erosion)	<ul style="list-style-type: none"> • Herbicide/pesticide spraying or runoff (grasshopper control) • Herbicide/pesticide spraying or runoff and nonpoint source pollution • Nutrient loads • Pesticide spraying (prey reduction) • Poisoning (fire ant insecticides) • Reduced water quality due to herbicide/pesticide runoff
	9.4 Garbage & Solid Waste Rubbish and other solid materials including those that entangle wildlife	

¹⁰ In Salafsky et al. (2008), pathogens are not split out as a separate threat. However, there are several pathogens causing significant impacts to SGCN, and we found it useful to create an additional category for this threat.

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Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
	9.5 Air-Borne Pollutants Atmospheric pollutants from point and nonpoint sources (e.g., acid rain, smog from vehicle emissions, excess nitrogen deposition)	<ul style="list-style-type: none"> Air pollution (precipitating/concentrating on high elevation snow fields)
	9.6 Excess Energy Inputs of heat, sound, or light that disturb wildlife or ecosystems (e.g., noise from highways or airplanes, heated water from power plants, lamps attracting insects)	
10 Geological Events Threats from catastrophic geological events	10.1 Volcanoes (<i>not applicable to Colorado</i>)	
	10.2 Earthquakes/Tsunamis (<i>not likely to be applicable to Colorado</i>)	
	10.3 Avalanches/Landslides Avalanches or landslides	
11 Climate Change & Severe Weather Threats from long-term climatic changes which may be linked to global warming and other severe climatic/weather events that are outside of the natural range of variation	11.1 Habitat Shifting & Alteration Major changes in habitat composition and location (e.g., desertification, tundra thawing)	<ul style="list-style-type: none"> Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados) Habitat shifting and alteration due to climate change
	11.2 Droughts Periods in which rainfall falls below the normal range of variation (e.g., severe lack of rain, loss of surface water sources)	<ul style="list-style-type: none"> Lack of water due to drought and exacerbated by climate change
	11.3 Temperature Extremes Periods in which temperatures exceed or go below the normal range of variation (e.g., heat waves, cold spells, disappearance of glaciers)	
	11.4 Storms & Flooding Extreme precipitation and/or wind events (e.g., thunderstorms, tornados, hailstorms, ice storms or blizzards, dust storms)	<ul style="list-style-type: none"> Climate variability (e.g., prolonged rain or hail events)
12 Organizational Capacity and Management* Inability to implement effective conservation measures due to lack of goal/policy alignment across agencies and stakeholders, lack of dedicated funding sources, institutional barriers to coordination	12.1 Lack of Coordination	

Level 1	Level 2 (general threats in Tables 7 & 8)	Level 3 – illustrative examples (specific threats in Tables 7 & 8)
	12.2 Lack of Funding	
	12.3 Lack of Common Goals	
	12.4 Confused or Gaps in Authorities	
	12.5 Legislation/Policy Changes	
13 Lack of Knowledge* Inability to determine priorities for what/when/where conservation action is needed due to poor understanding of species needs	13.1 Complete Distribution in Colorado Unknown	
	13.2 Critical Life History/Habitat Components Unknown	
	13.3 Genetic Relationship with Other Subspecies Unknown	
	13.4 Population Status Unknown	
	13.5 Population Trend Unknown	
	13.6 Response to Change, Disturbance, & Other Threats Poorly Understood	
14 Natural Factors* Life history traits that contribute to species' vulnerability and warrant management attention or influence effectiveness of potential conservation approaches	14.1 Scarcity (leading to inbreeding depression)	
	14.2 Low Annual Recruitment	
	14.3 Low Reproductive Rate	
	14.4 Nest Predation	
	14.5 Competition	
	14.6 Loss of Species from Suitable Habitat	

Overview of Threats to Biodiversity in Colorado

This section provides a very brief overview of the major threats to biodiversity in Colorado. We highlight here the primary issues related to the threats that affect many SGCN and/or are widely distributed across the state. These narratives are far from exhaustive, and are intended only as a simple synopsis to help readers understand the primary ways in which various threats interact with and on species and/or their habitats. As previously noted, many of these issues are closely related to each other, and interact in complex ways. A single threat likely has multiple adverse impacts, and each adverse impact may be coming from multiple threats. Teasing apart the cumulative effects of multiple threats for each SGCN is a dizzying task that exceeds the scope of this SWAP. Our goal here is to illuminate the most crucial conservation and research needs, and to support on-going conservation planning at more localized landscape, species and habitat-

specific scales. We have focused attention on threats that are currently known to be affecting SGCN and their habitats within Colorado, or that are considered likely to impact these resources in the foreseeable future. Many species cross state and international boundaries, especially birds. Conservation activities in other parts of these species' ranges are important, but are beyond the scope of Colorado's SWAP. Past activities that have ceased or are no longer threatening SGCN at the population level, and thus are not likely to drive conservation decisions over the next 10 years, are not considered major threats in this SWAP.

Throughout this document, threats are discussed in the order presented in the Salafsky lexicon. In the following section, threats that are not applicable in Colorado have been omitted.

1 Residential & Commercial Development

The most obvious impact of residential and commercial development is complete destruction of native habitat, as woodlands, grasslands, etc. are replaced by buildings and pavement. Other impacts include alteration of the local hydrology. One very significant impact is the damming and diversion of natural waterways to provide increased water availability for larger human populations (see following section on hydrological modification for more on this). Hard surfaces such as pavement prevent infiltration of storm water, which increases the quantity of runoff into surface creeks and streams, and decreases the augmentation of groundwater and moisture availability for plants' root zones. This runoff may be tainted by fertilizers, pesticides, motor oil, pharmaceuticals, and myriad other pollutants. Areas of residential and commercial development also change species dynamics, such as predator/prey relationships and competition among species for food/shelter resources. Examples include introduction of domestic predators (such as house cats and dogs) and increasing numbers of urban-adapted meso-predators (such as raccoons and foxes), as well as proliferation of weeds that out-compete native plant species (thus changing the food and cover resources available for wildlife). Furthermore, species that some consider pests, such as bats, prairie dogs, and predators, may be intentionally exterminated. Residential and commercial development and accompanying roads, utility corridors, and other infrastructure fragment native habitats. This can result in wildlife being confined to patches of habitat that are too small to sustain populations, and too far apart for individuals to move between. Ripple effects of growing urbanization also include increased recreational pressure on surrounding natural areas.

2 Incompatible Agriculture

2.1 Cropland

Like residential and commercial development, conversion to cropland replaces native habitats with row crops, hay fields, and so on. Agricultural fields still provide habitat components, such as food and cover, for some wildlife species. This is especially true for crop fields that are retired into the Conservation Reserve Program and seeded with seed mixes appropriate to the local native wildlife. However, activities associated with agricultural production, such as plowing, tilling, and mowing, can be fatal to species that inhabit agricultural fields. Use of herbicides, pesticides, and insecticides may kill native species outright, or have indirect impacts such as reduction in food resources (insects, seeds, etc.) that lower wildlife species' health, reproductive success, and/or ability to survive migration or winter. Perhaps most important of all, much of the water management that adversely affects many species and habitats is driven by the need for irrigation to sustain crop agriculture. Over 80% of the water delivered in Colorado goes to agricultural uses (<http://www.coloradowater.org>). Some of the same concerns for residential and commercial development relative to water quality and quantity also apply to cropland.

2.3 Livestock Farming & Ranching

Livestock farming and ranching can have positive or negative influences on habitats, depending on how it is conducted and the specific habitat in question. In extensive grasslands, such as those on Colorado's eastern plains, the ecological system has historically been maintained by grazing and browsing animals (such as bison, pronghorn, and prairie dogs), and the plant species that are typical of grasslands have evolved to withstand these pressures. Likewise, the wildlife species that live in grasslands have evolved to inhabit a variety of habitat niches created by native grazers, which historically included a mosaic of bare ground, very short grass, mid-height grass, and shrub patches. In the absence of free-ranging bison, livestock ranching is now the primary tool available to maintain the health of grassland systems. However, ranching practices often reduce the heterogeneity of this landscape matrix, such that many grasslands are now characterized by fences, homogenous structure, and reduced native species. These conditions are less suitable for many grassland species. Other ways that livestock ranching may reduce habitat suitability for wildlife include seeding of non-native pasture grasses; reduction or loss of palatable native grass and forb species; an increased percentage of unpalatable grass and forb species; and potential for degraded riparian zones (soil compaction, increased runoff leading to gullying, downcutting, lowered water table, and loss of riparian vegetation). Predator and prairie dog control is also a common component of grazing management.

Other habitats that have not evolved with grazing as a primary disturbance are more likely to experience changes in plant structure, species composition, increased soil disturbance and erosion, and/or spread of invasive weeds. For example, livestock grazing in pinyon-juniper has greatly reduced the presence and functioning of biological soil crusts, and increased the

incidence of weeds, especially cheatgrass. Proliferation of cheatgrass changes the characteristics of wildfire, with a number of consequences, including altering the density of vegetation and the ability of native plant species to regenerate. Domestic sheep grazing in the alpine can alter species composition of tundra communities.

Although some agricultural activities pose an ongoing threat to wildlife, it should be noted that ranching and farming are also critical to maintaining numerous wildlife populations.

Agricultural practices preserve open space and provide sources of concentrated food and cover that would not otherwise exist. Examples include wild ungulate use of croplands and irrigation practices that create wetlands and reservoirs. Without these contributions, it is highly doubtful that Colorado could support current populations of deer, elk, waterfowl and shorebirds or the present number of recreational fishing opportunities that now exist.

3 Energy Production & Mining

3.1 Oil & Gas Drilling

Oil and gas development involves a complex series of exploration and production activities, and includes associated infrastructure such as well pads, pipelines, and roads. The footprint of oil and gas development is dependent upon how densely pads are sited (for example, one pad per 640-acre section versus one pad per five acres or multiple pads per acre). Impacts to terrestrial wildlife include habitat conversion and behavioral avoidance of areas where humans and infrastructure are present. In addition, there may be negative impacts associated with the increased noise associated with drilling and operating wells or transfer stations. Aquatic wildlife are affected as well. A significant amount of water is used in drilling, followed by disposal of contaminated water post-drilling. Water polluted with toxic chemicals can have significant effects on a variety of species, including fish and aquatic insects, amphibians, wading birds, and riparian vegetation, among others. For those species where oil and gas is listed as a threat, the use of BMPs is likely appropriate at a site-specific scale. However, to fully mitigate these impacts, the planning, implementation, and mitigation of oil and gas activities need to be carried out at much larger scales, as appropriate to the landscape that these various species inhabit.

3.2 Mining & Quarrying

Mining and quarrying destroy habitat, and have a variety of indirect effects on wildlife. Mining can contaminate streams via leaching of newly exposed rock and chemicals associated with the mining process itself. Past mining of silver, gold, and uranium continue to negatively impact water quality of large rivers and streams. For example, the Upper Arkansas and Las Animas Rivers have elevated levels of heavy metals, which have resulted in an overall decrease in aquatic fauna, including reduced fish productivity and loss of some aquatic insect species. Sand and gravel mining operations are typically near rivers and streams, where they impact hydrologic

flow and patterns, with resultant loss or degradation of riparian vegetation, including the cottonwood galleries and understory shrubs and herbaceous plants that provide cover and food resources for wildlife. Mining for resources such as coal and molybdenum can reduce both air and water quality.

3.3 Renewable Energy

Wind, solar, geothermal, and biofuels energy production continue to grow throughout the state. While these renewable sources of energy are important to pursue for a variety of reasons, they also come with potential for adverse impacts to wildlife. Most of the wind energy development is occurring in the eastern prairie region, with consequent impacts (at least localized) on some species, especially birds and bats. Impacts include behavioral avoidance and collision with turbines. Like traditional means of energy production, all forms of renewable energy production increase habitat fragmentation with associated roads and transmission lines. Many of the same issues associated with crop agriculture also apply to biofuel production.

4 Transportation & Service Corridors

4.1 Roads & Railroads

The most significant impact of roads at a landscape scale is fragmentation of habitat. At its most basic, fragmentation refers to the change from large, contiguous areas of suitable habitat to smaller units of suitable habitat, interspersed with areas of, essentially, non-habitat (road surfaces, urban areas, and so on), as well as an overall decrease in the total amount of habitat available. The size of habitat patches, number of patches, and distance between patches that constitute fragmentation is variable, depending on the species. Fragmented habitat is also qualitatively different from non-fragmented habitat, in terms of which species are present, amount of light and moisture, relative temperature, and a host of other factors that influence whether or not a given species can continue to thrive in that place. Fragmentation from roads can be variable, depending not only on the species, but also on the size of the road, speed of traffic, and volume of traffic.

Other impacts of roads are alteration of local hydrology (quantity and flow patterns of runoff), altered rates of erosion and sedimentation in nearby waterbodies, and pollution from motor oil, gasoline, de-icing agents, and other chemicals. A related threat from roads and railroads is the potential for catastrophic spills of toxic materials. Infrastructure related to road crossings (bridges, culverts) can create barriers to fish movement. Construction and use of roads are significant vectors for weeds, and right-of-way maintenance (mowing, application of herbicides) can adversely impact native species, as well as their food and cover resources. Lastly, of course, roads can be a significant source of mortality for animals that cross roads (especially slow animals such as turtles and amphibians) or bask on roads (such as snakes and lizards). Roads can

also be a significant local source of mortality for highly mobile species such as elk, mule deer, and many smaller animal species.

4.2 Transmission & Service Lines

Impacts from transmission lines include electrocution of birds and bats, disturbance from right-of-way maintenance, introduction of vertical structure within habitats that provide perches for raptors, and introduction and spread of noxious weeds. Transmission lines can also contribute to habitat fragmentation, depending upon their density, siting, and design.

5 Biological Resource Use

5.1 Control of Nuisance Species & Collecting

Intentional control or persecution of native species that are considered pests by some people is a threat for several SGCN. Chief among these are the three species of prairie dog (black-tailed, white-tailed, and Gunnison's), as well as bats that use human dwellings and other buildings. Prairie dogs are removed for a variety of reasons, including to make way for residential and commercial development, and to improve forage availability for domestic cattle. However, prairie dogs are crucial components of ecosystems that support a myriad of other species, some of whom can not persist without the dens and prey base that prairie dogs provide. Several of the SGCN identified in this document are of conservation concern, at least in part, due to the dramatic reduction in prairie dogs.

5.3 Logging & Wood Harvesting

Like grazing, the harvesting of timber can be used as a tool for enhancing habitats, or it can pose threats to native wildlife species, depending on where, when, and how it is conducted. Use of appropriate silvicultural practices in appropriate forest types is not considered a threat to the forest type or wildlife species that occur in that forest type. Appropriate silvicultural prescriptions would be those that mimic natural disturbances in both size and scale across a given area. Wildlife species that evolved in these forested environments are resilient to disturbances that are caused by natural processes. Logging could be considered a threat when it does not mimic natural ecological disturbances in size and prescription.

6 Human Intrusions & Disturbance

6.1 Recreational Activities

Colorado residents and visitors are fortunate in the vast array of recreation opportunities our state has to offer. However, when not managed appropriately, recreationists can have significant impacts on native wildlife. Access roads fragment habitat, construction and use of trails introduce weeds, and the presence of humans and their pets can disturb wildlife, potentially

leading to abandonment of nest sites, feeding or wintering areas, and other important habitats. Hiking and climbing too close to cliff faces and edges disturbs nesting raptors, and caving can cause abandonment of bat maternity roosts and winter hibernacula. Off-road vehicles can damage stream crossings, wetlands, and vegetation; lead to increased erosion and sedimentation; spread noxious weeds; and facilitate poaching. In addition, noise, unpredictable human presence, and disturbance from motorized recreation can lead to wildlife avoiding or abandoning habitat. Any disturbance during winter (skiing, snowmobiling) that causes wildlife to flee could result in an expenditure of energy reserves needed to survive winter.

7 Natural Systems Modifications

7.1 Fire & Fire Suppression

Many of Colorado's forests and shrublands have evolved with periodic wildfires. In these ecosystems, fire maintains a heterogenous landscape (and thus a variety of habitat types) by controlling the density of trees and shrubs, creating forest openings, regenerating decadent stands, and supporting reproduction (for example, in species that require fire to germinate seeds). Historic fire regimes are out of balance across much of the American West, due primarily to a century of fire suppression. When natural wildfires are routinely put out, trees become denser and understory fuels (leaf litter, needle duff, downed woody debris, etc.) accumulate. In addition, other natural processes such as insect and disease disturbances may become unbalanced. The ultimate result of these cumulative effects is wildfire that burns hotter and faster, and is more likely to spread into the tree canopy. Wildfires that occur too frequently or burn too intensely can have catastrophic impacts on soil and water resources. Extremely high temperatures can sterilize soil, eliminating its ability to support plant regrowth. Excessive erosion can result in significant reduction in water quality, as well as restructuring of river and stream channels, which alters the types, quality, and amount of suitable habitat for aquatic species. Future threats from wildfire are expected to be exacerbated by climate change.

7.2 Dams & Water Management/Use

Dams and the management and use of water have a multitude of complex effects on wildlife and their habitats. Dams themselves replace habitat outright. The operation of dams directly affects the timing, volume, and temperature of flows, and indirectly affects many closely related habitat characteristics, including transfer of sediments, oxygen levels, support of riparian vegetation, and a host of others. The use of water involves diversions (piping water from one basin to another, irrigation canals, and so on), channelization of rivers and streams, groundwater pumping, and other means of removing water from rivers. Some of the results include, but are not limited to, flattening of the hydrograph, alteration of the quantity, duration, timing, and intensity of high or low flow events (floods, droughts), patterns of erosion & sedimentation that are incompatible with wildlife needs, and barriers to fish movement. Many riparian and wetland plants, the basis

of crucial habitat for many species of wildlife, require specific conditions to germinate, grow, and reproduce. The amount of water in surface and groundwater systems is directly related to whether or not these species can survive. Likewise, the amount of water, temperature of the water, chemical composition and clarity of water determine whether or not fish can successfully spawn, obtain sufficient food, elude predators, survive winter, and so on. Seasonal timing of when specific conditions occur (high flows, low flows, scouring floods, etc.) is also very important for aquatic and riparian species. All these habitat characteristics are either supported or degraded by the ways in which water is managed and used.

7.3 Other Ecosystem Modifications

For the purposes of this SWAP, we have used the term “other ecosystem modification” as a catch-all category when causes of stress are so multi-faceted that teasing out major contributors is uncertain, or when stresses are apparent but causes are unknown.

8 Invasives, Problematic Native Species, & Pathogens

8.1 Invasive Non-Native Species

Invasive non-native species are plants or animals that have been introduced into local ecosystems, usually as a result of human activity. Non-native species that become established are often able to out-compete native species for required resources, prey on native species, and/or hybridize with native species. This can lead to reduced abundance, altered distribution, or constricted range of native species. Other impacts could include altered food webs, reduction of reproductive success, health/vigor, and/or overwinter survival, or total elimination of native species from the area. Examples of non-native plants with significant impacts on native wildlife and their habitats include tamarisk, leafy spurge, and cheatgrass, among a host of others. Non-native animals include a variety of introduced sport fish, bullfrogs, zebra mussels, red-eared sliders, and Eurasian collared doves, among others.

8.2 Problematic Native Species

Problematic native species are those that naturally occur in an ecosystem, but have become out of balance. In the absence of native predators, elk have proliferated in some places to the point that they are degrading willow carrs and aspen stands. Species such as coyotes, raccoons, crows and ravens can also become out of balance when there are artificial food sources or a lack of top level predators that would naturally suppress populations. Insects such as mountain pine and spruce beetles are native to Colorado. These insects are a natural disturbance process that helps maintain forest ecosystems. However, a variety of factors, including increased temperature, drought, and – in some cases – fire suppression, have contributed to very severe insect outbreaks and significant tree mortality across the state. The effects of climate change can increase these threats.

8.4 Pathogens

A number of pathogens are having significant impacts on SGCN in Colorado. Sylvatic plague can greatly reduce prairie dog abundance, affecting not only the prairie dogs themselves, but also the myriad of species that use or rely on prairie dogs. Plague and canine distemper are significant problems for recovery of black-footed ferrets, a federally-listed endangered species. Chytrid fungus has been implicated in extreme declines in boreal toads, and may be related to declines in northern leopard frogs as well. Bighorn sheep are being impacted by respiratory disease caused by *Pasteurellacea* and *Mycoplasma* bacteria. Whirling disease has contributed to the collapse of wild trout populations in the western U.S. and is considered a threat to Colorado's native cutthroat trout. White-nose syndrome, a fungal disease in bats first detected in New York in 2006, has decimated some bat populations in the eastern U.S., and is moving westward. Though this disease has not yet been documented in Colorado, as of 2014 it was documented as far west as the Missouri/Kansas border. The potential exists for it to pose significant future threats to some SGCN.

9 Pollution

9.1 Household Sewage & Urban Waste Water

Housing and urban areas are a source of pollutants that enter Colorado waters. Developed areas have large coverage of impervious surface (pavement, buildings) and other land with impaired drainage that increase the amount of runoff and carry nutrients, toxic chemicals and/or sediments (e.g., discharge from municipal waste treatment plants, leaking septic systems, fertilizers and pesticides from lawns and golf-courses). These pollutants may be harmful to both aquatic and terrestrial plants and animals. Species near housing and urban areas are most likely to be impacted, but effects can be far-reaching.

9.2 Industrial & Military Effluents

Industrial and military activities can also be a source of water-borne pollutants. Resource extraction and industrial activities including mining, energy production, and manufacturing, especially those that require large amounts of water, can release nutrients, toxic chemicals and/or sediments into the water. Pollution may be incremental with cumulative effects, or accidental spills may introduce large quantities of pollutants during a single episode.

9.3 Agricultural & Forestry Effluents

Runoff of herbicide and pesticide applications in both cropland and forested areas are a primary source of water-borne pollutants from these activities. Increased sedimentation in the local watershed is also likely to result from certain tillage or lumber harvest activities.

9.5 Air-Borne Pollutants

Atmospheric deposition (air pollutants deposited to ecosystems) occurs in both wet deposition through rain, snow, cloud or fog, and as dry deposition via dust and gases. Atmospheric pollutants may come from both point and nonpoint sources (e.g., acid rain, smog from vehicle emissions, excess nitrogen deposition). Atmospheric nitrogen and sulfur deposition can change water chemistry and thereby impact aquatic vegetation, invertebrate communities, amphibians, and fish.

11 Climate Change & Severe Weather

Climate projections for Colorado are generally in agreement that the state will experience temperatures that are 2-5 °F warmer than current temperatures by mid-century¹¹. Projections for future precipitation are variable, ranging from very dry to approximately 10% wetter than current conditions. Moisture increases are more likely for winter; projections for summer precipitation are highly variable, especially for precipitation associated with monsoonal rains. Elevations below approximately 8,000 feet are likely to experience increasing amounts of annual moisture as rain rather than snow. A potential for changes in El Niño/La Niña effects may lead to extreme wet years followed by extreme dry years, which could have significant impacts to wildlife and their habitats.

As part of the SWAP revision process, we conducted a habitat-based climate change vulnerability assessment. The results of that work are summarized in Appendix F of this document. The full technical report can be obtained from CNHP or accessed online¹².

How climate change will ultimately manifest in Colorado, as well as potential impacts to wildlife species and habitats, is largely unknown at this point. To the best of our ability to estimate, we presume that some potential impacts could include those listed below. This same caveat applies to most of the climate change narrative in the species summaries that follow. Though much of this information is speculative, it represents our best professional judgment given the information available to us, until such time as more focused research results become available.

11.1 Habitat Shifting & Alteration

As temperatures increase and precipitation regimes change, suitable climatic conditions for species and/or habitats may shift in elevation or latitude. There is the potential for this to result

¹¹ The full range of projected temperature increase across all emissions scenarios at mid-century vary from 1.5 to 6.5 degrees warmer; late-century projections vary from 1.5 to 9.5 degrees warmer. See <http://wwa.colorado.edu/climate/co2014report> for the complete set of projections.

¹² http://www.cnhp.colostate.edu/download/documents/2014/CO_SWAP_Enhancement_CCVA.pdf

in different tree, shrub, and understory species dominating the landscape. In the future, we may see novel plant communities¹³ emerge or significant loss of current communities.

11.2 Drought

Drought is a natural component of the climate in the arid West, with fluctuations between wet years and dry years typical. As temperatures across Colorado warm, we may experience more frequent and intense droughts – periods in which precipitation and soil moisture is below normal – with consequent changes in which plant and animal species can survive, and an overall decrease in plant vigor. Past extreme droughts, such as those experienced in 2002 and 2012, have impacted a number of species (blue grama, spruce, lodgepole, aspen, and pinyon pine). Similar scenarios may become more familiar as climate change progresses.

11.3 Temperature Extremes

Colorado's future climate is expected to include warmer temperatures overall, as well as more frequent and/or extended periods when temperatures go above or below what we have historically considered normal. We are likely to experience more frequent and extended heat waves, and fewer cold spells of the type that control insect populations. Warmer temperatures on average, even without extremes, are likely to produce earlier snowmelt and peak runoff, more precipitation falling as rain instead of snow, increased moisture stress for some wildlife species and their habitats, and potential impacts on seed production/germination and growth of various plant species. These changes will have direct impacts on wildlife habitats, rendering some areas unsuitable for species that currently live there and providing new opportunities for other species to colonize.

11.4 Storms & Flooding

As global climate continues to change, Colorado may experience increased frequency and/or severity of extreme precipitation and/or wind events, thunderstorms, damaging hail, tornados, dust storms, and ice or snow storms. Potential effects include changes in habitats – examples include large areas of windthrow in forests and scouring of rivers and streams.

12 Organizational Capacity & Management

To appropriately manage and conserve wildlife and their habitats, it is necessary for agencies, researchers, non-governmental organizations, and others involved in this work to collaborate, share information and resources, and support each other's efforts. Lack of alignment in goals, bureaucratic obstacles to cooperation, and lack of resources are some examples of what we mean by the "threat" of organizational capacity and management. Other examples include lack of guidance or regulatory documents such as recovery plans to direct conservation action. Field

¹³ For the purposes of the SWAP, we can interpret plant communities to be roughly equivalent to habitat types.

staff workloads exceed staffing for many conservation agencies, and this forces work strategy to be reactive rather than proactive. Increasing the capacity of agencies by increasing staffing where possible, finding and developing efficiencies, and collaborating to greater extents may alleviate some of this conservation threat.

13 Lack of Knowledge

Effective wildlife management and conservation requires sufficient understanding of life history and habitat requirements, distribution, relationships among species, effects of management interventions in habitats, and so on. It is also important to understand responses of non-target species to management and conservation practices (for example, grazing prescriptions, pinyon-juniper removal). Incomplete knowledge inhibits our ability to identify and interpret potential threats and decide on appropriate course(s) of action.

14 Natural Factors

For the purposes of the SWAP, this category has been included to address issues related to conservation status or life history characteristics that contribute to vulnerability. These include scarcity, out of balance inter-species relationships such as predation and competition, and reproductive success. In many cases, threats addressed in the SWAP as natural factors are, in fact, products of a variety of interacting human impacts.

Overview of Conservation Actions

Similar to the threats descriptions in the previous section, the following narratives are intended to give readers a general understanding of the types of conservation and management activities that might be undertaken to improve the status of SGCN and their habitats in Colorado. They are not comprehensive, but they illustrate the types of strategies and actions that are proposed or suggested in the species and habitat narratives that follow, and in Tables 7 and 8. Standards and practices for conservation and habitat management are always evolving. In addition, the specifics of “who,” “how,” and so on are often highly contingent upon local conditions. Thus we do not consider the statewide SWAP to be the most appropriate venue for prescribing conservation action methods. However, to provide general guidance for project planning, we include examples of the types of activities that might be employed to achieve conservation goals, as appropriate.

Table 6. Lexicon of conservation actions according to Salafsky et al. 2008.

Actions marked with an asterisk (*) are not included in Salafsky et al. (2008), but we have determined that they are needed to fully express conservation needs in Colorado.

Level 1	Level2 (general actions in Tables 7 & 8)	Level 3 – illustrative examples (specific actions in Tables 7 & 8)
<p>1 Land/Water Protection Actions to identify, establish or expand parks and other legally protected areas</p>	<p>1.1 Site/Area Protection Establishing or expanding public or private parks, reserves, and other protected (e.g., national parks, wildlife sanctuaries, private reserves)</p>	
	<p>1.2 Resource & Habitat Protection Establishing protection or easements of some specific aspect of the resource on public or private lands (e.g., easements, development rights, water rights, instream flow rights, wild and scenic river designation)</p>	<ul style="list-style-type: none"> • Acquire conservation easement for habitat protection • Acquire water rights or instream flow rights
<p>2 Land/Water Management Actions directed at conserving or restoring sites, habitats and the wider environment</p>	<p>2.1 Site/Area Management Management of protected areas and other resource lands for conservation (e.g., site design, demarcating borders, putting up fences, training park staff, control of poachers)</p>	<ul style="list-style-type: none"> • Coordinate on ecologically sensitive design of recreational facilities • Employ grazing as a tool for compatible vegetation cover, structure, composition • Implement compatible forest management • Implement compatible grazing practices • Implement seasonal closures • Manage public use to be compatible with biodiversity • Manage to limit disturbance, especially to roost sites, maternity colonies, and hibernacula
	<p>2.2 Invasive/Problematic Species Control Controlling and/or preventing invasive and/or other problematic plants, animals, and pathogens</p>	<ul style="list-style-type: none"> • Control bullfrogs • Control non-native birds • Control non-native fish • Control non-native plants • Manage research, management, and recreation activities to control the spread of pathogens • Remove tamarisk through biological, chemical, mechanical means and prevent re-establishment • Write and/or implement integrated weed/pest management plan

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Level 1	Level 2 (general actions in Tables 7 & 8)	Level 3 – illustrative examples (specific actions in Tables 7 & 8)
	<p>2.3 Habitat & Natural Process Restoration Enhancing degraded or restoring missing habitats and ecosystem functions (e.g., creating forest corridors, prairie re-creation, riparian tree plantings, prescribed burns, breaching levees, dam removal, fish ladder)</p>	<ul style="list-style-type: none"> • Adjust operation of dam • Employ grazing as a tool for compatible vegetation cover, structure, composition • Implement streambank or in-stream restoration • Improve erosion and excess sedimentation conditions • Improve status of prairie dogs • Maintain appropriate patch size and habitat mosaic • Maintain connectivity (e.g., wildlife over/under passes, habitat corridors, fish passages) • Manage caves/mines for native bats • Re-seed native species • Restore native habitat • Restore native understory species • Restore natural fire regime • Restore riparian vegetation & hydrologic regime
<p>3 Species Management Actions directed at managing or restoring species, focused on the species of concern itself</p>	<p>3.1 Species Management Managing specific plant and animal populations of concern (e.g., harvest management of wild mushrooms, culling buffalo to keep population size within park carrying capacity, controlling fishing effort)</p>	<ul style="list-style-type: none"> • Develop and implement active disease management program • Develop proactive conservation program • Implement existing management/recovery plan • Maintain deer/elk populations within carrying capacity for healthy habitat • Reduce nest predators • Write and implement management/recovery plan
	<p>3.2 Species Recovery Manipulating, enhancing or restoring specific plant and animal populations, vaccination programs (e.g., artificial nesting boxes, clutch manipulation, supplementary feeding, disease/parasite management)</p>	<ul style="list-style-type: none"> • Maintain genetic connection/integrity within and between populations • Provide artificial nesting boxes/platforms • Reduce nest predators
	<p>3.3 Species Re-Introduction Re-introducing species to places where they formally occurred</p>	<ul style="list-style-type: none"> • Re-introduce extirpated native species • Translocate species to historic range

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Level 1	Level 2 (general actions in Tables 7 & 8)	Level 3 – illustrative examples (specific actions in Tables 7 & 8)
	<p>3.4 Ex-Situ Conservation Protecting biodiversity out of its native habitats (e.g., captive breeding, artificial propagation, gene banking)</p>	
<p>4 Education & Awareness Actions directed at people to improve understanding and skills, and influence behavior</p>	<p>4.1 Formal Education Enhancing knowledge and skills of students in a formal degree program (e.g., public schools, colleges and universities, continuing education)</p>	
	<p>4.2 Training Enhancing knowledge, skills and information exchange for practitioners, stakeholders, and other relevant individuals in structured settings outside of degree programs (e.g., monitoring workshops or training courses, learning networks or how-to manuals, stakeholder education on specific issues)</p>	<ul style="list-style-type: none"> • Educate development industries about avoiding and/or mitigating wildlife impacts • Improve communication among researchers and policy/decision-makers • Improve knowledge of species, habitats, problems, via professional meetings and other venues
	<p>4.3 Awareness & Communications Raising environmental awareness and providing information through various media</p>	<ul style="list-style-type: none"> • Implement landowner outreach/education and incentives programs • Publish educational material/sponsor educational programs to raise public awareness
<p>5 Law & Policy Actions to develop, change, influence, and help implement formal legislation, regulations, and voluntary standards</p>	<p>5.1 Legislation Making, implementing, changing, influencing, or providing input into formal government sector legislation or policies (e.g., state ballot initiatives, providing data to policy makers, zoning regulations, species protection laws)</p>	

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Level 1	Level 2 (general actions in Tables 7 & 8)	Level 3 – illustrative examples (specific actions in Tables 7 & 8)
	<p>5.2 Policies & Regulations Making, implementing, changing, influencing, or providing input into policies and regulations affecting the implementation of laws at all levels: international, national, state/provincial, local/community, tribal (e.g., input into agency plans regulating certain species or resources, working with local governments or communities to implement zoning regulations, promoting sustainable harvest on state lands)</p>	<ul style="list-style-type: none"> • Encourage use of Farm Bill programs • Establish mitigation requirements for developments • Monitor water quality standards • Promote consideration of biodiversity issues in transportation and land use planning processes • Promote zoning that concentrates use and protects habitat • Provide incentives for homeowners to increase tolerance of bats • Work with state and federal partners to limit density of oil/gas leasing and development
	<p>5.3 Private Sector Standards & Codes Setting, implementing, changing, influencing, or providing input into voluntary standards & professional codes that govern private sector practice (e.g., Conservation Measures Partnership Open Standards, corporate adoption of forestry best management practices, sustainable grazing by a rancher)</p>	<ul style="list-style-type: none"> • Implement Best Management Practices for <ul style="list-style-type: none"> ○ agricultural production ○ energy development & mining ○ forest management ○ livestock grazing ○ transportation, urban development, landscaping ○ water resource management
	<p>5.4 Compliance & Enforcement Monitoring and enforcing compliance with laws, policies & regulations, and standards & codes at all levels (e.g., water quality standard monitoring, initiating criminal and civil litigation)</p>	<ul style="list-style-type: none"> • Enforce 404 wetlands regulations • Enforce hunting, fishing, collecting regulations • Enforce state/federal/local pollution standards • Enforce wildlife and habitat protection laws • Enforce travel regulations

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Level 1	Level 2 (general actions in Tables 7 & 8)	Level 3 – illustrative examples (specific actions in Tables 7 & 8)
<p>6 Livelihood, Economic & Other Incentives Actions to use economic and other incentives to influence behavior</p>	<p>6.1 Linked Enterprises & Livelihood Alternatives Developing enterprises that directly depend on the maintenance of natural resources or provide substitute livelihoods as a means of changing behaviors and attitudes (e.g., ecotourism, nontimber forest product harvesting)</p>	
	<p>6.2 Substitution Promoting alternative products and services that substitute for environmentally damaging ones (e.g., farmed salmon as a replacement for pressure on wild populations, promoting recycling and use of recycled materials)</p>	
	<p>6.3 Market Forces Using market mechanisms to change behaviors and attitudes (e.g., certification, positive incentives, grass and forest banking, valuation of ecosystem services such as flood control)</p>	
	<p>6.4 Conservation Payments Using direct or indirect payments to change behaviors and attitudes (e.g., quid-pro-quo performance payments, resource tenure incentives)</p>	<ul style="list-style-type: none"> • Implement the NRCS Black-footed Ferret Initiative program • Implement Purchase/Transfer Development Rights program for habitat protection • Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)
	<p>6.5 Non-Monetary Values Using intangible values to change behaviors and attitudes (e.g., spiritual, cultural, links to human health)</p>	
<p>7 External Capacity Building Actions to build the infrastructure to do better conservation</p>	<p>7.1 Institutional & Civil Society Development Creating or providing non-financial support & capacity building for non-profits, government agencies, communities, and for-profits (e.g., creating new local land trusts)</p>	

Level 1	Level 2 (general actions in Tables 7 & 8)	Level 3 – illustrative examples (specific actions in Tables 7 & 8)
	<p>7.2 Alliance & Partnership Development Forming and facilitating partnerships, alliances, and networks of organizations (e.g., Conservation Measures Partnership)</p>	<ul style="list-style-type: none"> • Coordinate with related agencies to align goals, policies, measures of success • Coordinate with related agencies to identify and secure funding • Engage in collaborative, proactive planning and conservation programs
	<p>7.3 Conservation Finance Raising and providing funds for conservation work (private foundations, debt-for-nature swaps)</p>	<ul style="list-style-type: none"> • Provide economic assistance for private land habitat improvements and/or species conservation
<p>8 Research and Monitoring* (general actions in Tables 7 & 8)</p>		<ul style="list-style-type: none"> • Conduct primary research on species and habitat responses to changing climate • Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing) • Research critical life history/habitat components • Research population parameters and/or monitor status. • Research species/habitat response to management • Research and develop an effective plague vaccine and delivery system • Research genetic relation to other (sub)species

1 Land/Water Protection

In the conservation community, the term “protect” as applied to private land refers to the acquisition of real property interest in land or water. In other words, a protection strategy involves purchase of land, development rights, or water rights for the purpose of preventing conversion or permanent loss of habitat. Types of actions that fall under the land/water protection category including purchase of land to establish preserves, sanctuaries, or parks; conservation easements that allow some uses (such as livestock grazing) but prohibit others (such as erections of homes or infrastructure); purchase of in-stream flow or water rights (for example, to maintain sufficient water in rivers and streams to support fisheries or waterbird populations);

and purchase or transfer of development rights programs (the right to build on a specific property is sold or traded for the right to build on a different property).

Protection strategies as applied to public lands include creation of new parks, monuments, or other conservation areas from publicly owned land, as well as special area designations such as Wilderness Areas, Research Natural Areas, Special Interest Areas, and so on. Management of these lands is based on specified allowable uses and activities, with a focus on conservation of specified natural resources (e.g., species, ecosystems, ecological processes). Examples of protection strategies as employed in Colorado include creation of the Great Sand Dunes National Park and Preserve, private preserves owned by The Nature Conservancy, the myriad of conservation easements held by Colorado's land trust community, the Transferred Development Rights program in Boulder County, and Colorado Water Conservation Board's Instream Flow Program. In the case of all these protection strategies, the destruction of habitat is, in effect, prohibited by law.

2 Land/Water Management

For the purposes of the SWAP, management of land and water encompasses the majority of activities that agencies and conservationists undertake to restore, maintain, or enhance the quality and function of ecological systems. This type of strategy can be applied to any habitat, regardless of land ownership. This category includes design and implementation of human activity and land use (for example, livestock grazing practices, forest management, recreation infrastructure) in a manner that is compatible with the needs of native wildlife species. Efforts to improve habitat condition or restore ecological processes are also included. A small sample of these include: weed control; realignment and rehabilitation of trails; adjusting the operation of dams to change the amount and timing of peak flows; planting of appropriate native species where vegetation has been damaged or to establish desired habitat structure; controlled burns to prevent catastrophic wildfire or to regenerate habitat; restoration of damaged streambanks or removal of instream barriers, and many more. Many habitat restoration projects require control of non-native or problematic species. Control of non-native vegetation might involve use of herbicides, fire, grazing, biocontrol, or other acceptable practices. Control of non-native animal species may consist of activities such as manual collection/removal, chemical control, and species-specific traps. Because many control methods have potential for negative impacts on non-target, sensitive native species, extreme care should be taken in adapting methods to site-specific needs. Management strategies are usually voluntary, and though they are often prescribed in agency management plans and similar strategic documents, they are generally not required by law.

3 Species Management

Species management strategies are actions that focus on particular species, rather than on habitats or ecosystems. Examples include culling herds, controlling fishing or hunting of particular species, relocation or re-introduction of species that have been lost from historically occupied habitat, captive breeding programs, and seed or gene banking. These activities are undertaken to improve the abundance, distribution, and health of particular populations, or of a species across its range. Species management strategies are most often employed for species that are hunted or fished, or species that have suffered precipitous declines and are in danger of extinction or extirpation. Two high-profile species management programs in Colorado are the captive breeding and re-introduction of black-footed ferrets, and the re-introduction of lynx.

4 Education & Awareness

Education and awareness strategies focus on people for the purpose of improving understanding and influencing behavior (Salafsky et al. 2008). Education may refer to formal degree programs, information sharing among professionals (workshops, conferences, and training programs), or activities to raise the awareness of the general public on issues concerning threats to species/habitats. Public awareness activities may be targeted toward people with interest in a particular issue, private landowners managing large acreages or significant habitats, or policy- and law-makers with influence over species and habitats, among others. CPW is engaged with many other entities in a cooperative, collaborative effort to deploy numerous private land biologists across the state. These collaborations have occurred with CPW, Rocky Mountain Bird Observatory, Natural Resources Conservation Service, Rocky Mountain Elk Foundation, Pheasants Forever, and in the past, Colorado Watershed network.

5 Law & Policy

Law and policy strategies involve formal government, and include laws as well as policies and regulations that guide interpretation and implementation. These are actions to develop, change, influence, and implement formal legislation, regulations, and voluntary standards. Examples include the Endangered Species Act and associated take permits, and permitting for development projects under the the National Environmental Policy Act or the Clean Water Act. This category also includes activities geared toward changing existing laws and regulations, such as ballot initiatives, and enforcement of existing laws, as well as local community codes and ordinances (such as land use zoning). Implementation of voluntary industry standards in both public and private enterprise is also considered a policy strategy. Examples include commitment to the use of Best Management Practices by the transportation, energy production, mining, forestry, and

agricultural industries. Note that proper use of Best Management Practices involves the careful articulation of what these practices entail, based on the particular species, suite of species, or habitat(s) that are of concern. In many cases, Best Management Practices do not currently exist, and would need to be developed. The State of Colorado, through several agencies, has developed some BMPs, but more work remains to be done.

6 Livelihood, Economic & Other Incentives

Livelihood, economic and other incentives involves the development, implementation and evaluation of programs intended to provide incentive for conservation-minded landowners to maintain their operations while also contributing to the net conservation benefit of a species or suite of species. Incentives can be delivered in several avenues. This may include using market forces to provide a value for ecosystem services such as flood control, conservation payments as a direct payment for conservation behavior, or non-monetary values where the incentives are something other than financial. Particular examples include mitigation banking, initiatives for participation in recovery of at-risk species such as the black-footed ferret, and credits for offsite habitat protection. The U.S. Department of Agriculture provides funds for habitat improvement and other conservation measures through a number of its Farm Bill programs. Species/habitat banks and crediting programs are increasing in Colorado as methods are developed, tested, and improved. The Farm Bill and other incentive or market-based programs can offer important benefits to species that rely on privately-owned land for a significant portion of their habitat(s). Managers and conservationists can encourage use of these programs by educating landowners on opportunities available, providing technical assistance on project design and implementation, and offering guidance on application process(es).

7 External Capacity Building

External capacity building describes actions that are intended to build infrastructure to do better conservation. The partnerships required to undertake the large-scale, meaningful conservation to aid in the long-term survival of many species and habitat types is covered by this action. This may involve the creation or provision of non-financial support and capacity building for non-profits, government agencies, communities and for-profits. It may also involve the forming and facilitation of partnerships, alliances and networks of organizations, and finally may involve the raising and provision of funds for conservation work. In some cases, alignment of policies and goals across agencies, in conjunction with implementation of conservation-compatible industry practices is needed. One example of this would be conservation of prairie dogs and associated species, where collaboration among state and local agencies and private landowners are needed to maintain viable populations of prairie dog species and the SGCN for which they create habitat.

8 Research & Monitoring

Research and monitoring actions are those that collect and use scientific information to assess population status, species response to various management techniques, habitat treatments, and many other aspects of wildlife management and conservation. Long-term research and monitoring can provide important ecological insights; both are very important for the improved management of SGCN, priority habitats, and treatments intended to benefit either.

Chapter 5: Threats and Actions for SGCN

Summary of Threats

Overall, lack of knowledge and natural systems modifications (including alteration of natural hydrological and fire regimes) are issues for the greatest number of Colorado's 159 vertebrate animal and mollusk SGCN (Figures 3–5). Lack of knowledge is a factor for over half of these SGCN – this is especially true for Tier 2 species. Impacts from non-native or problematic native species (including pathogens), habitat conversion (cropland, urban development), and incompatible agricultural practices are also significant for many SGCN. Of the 55 Tier 1 SGCN, more than half are affected by these threats. For descriptions of the threats represented in the figures below, refer to Chapter 4 and Table 5.

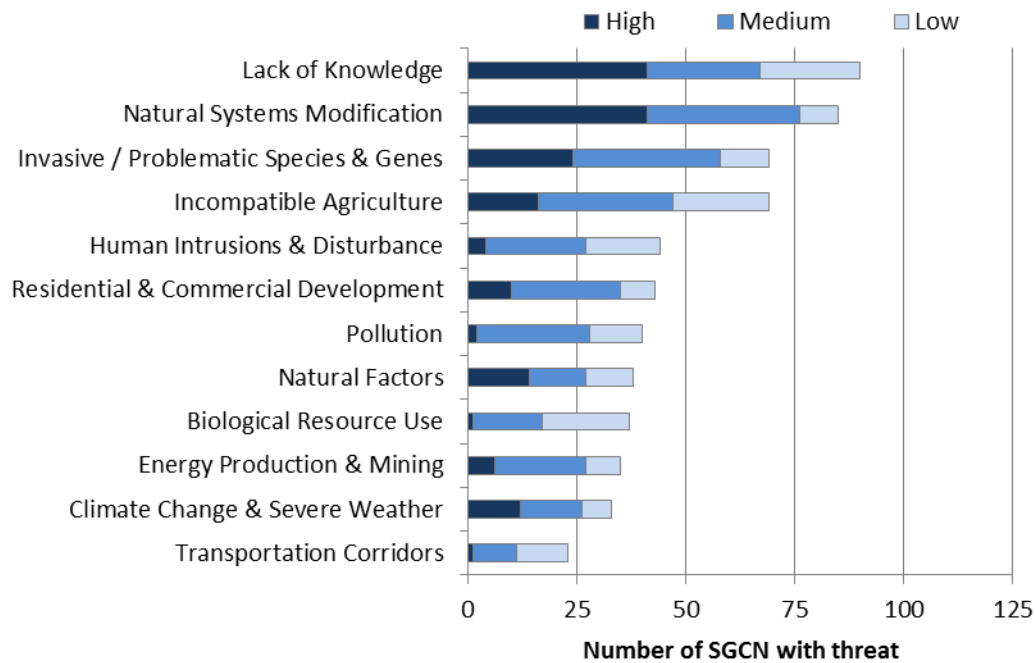


Figure 3. Threats to vertebrate and mollusk SGCN by priority.

Colorado's 2015 State Wildlife Action Plan

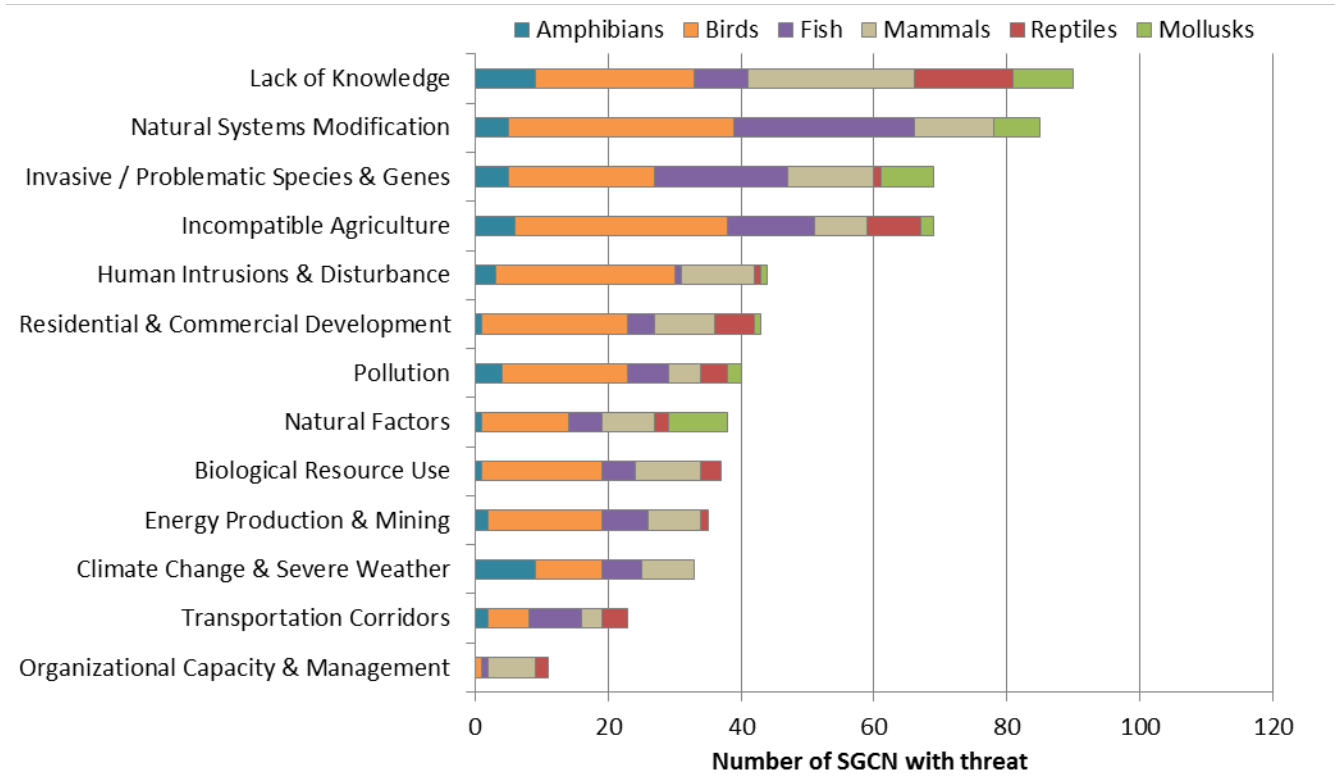


Figure 4. Threats to vertebrate and mollusk SGCN by taxonomic group.

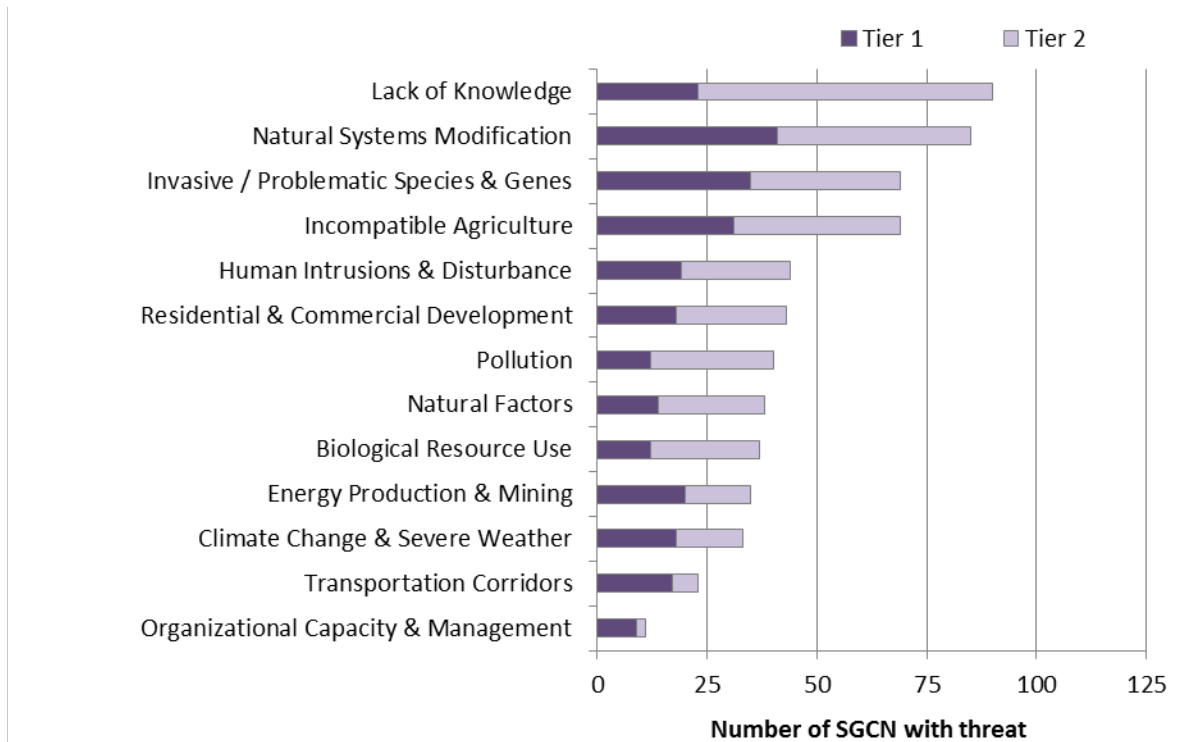


Figure 5. Threats to vertebrate and mollusk SGCN by Tier.

Summary of Conservation Actions Needed

The highest priority conservation actions for SGCN include research/monitoring and management or restoration of habitats and ecological processes (Figure 6). For Tier 1 SGCN, restoration is the most needed conservation action, especially for aquatic species (Figures 7 and 8). Private enterprise also has a crucial role to play through application of standards such as Best Management Practices. Land and resource protection (conservation easements, water rights), control of invasive species, and application of policy and regulation are all important as well. Given the complexity of land use and ownership patterns in the state, conservation success for SGCN will require increasing the breadth and effectiveness of partnerships. Conservation of Colorado's wildlife is too big a task for one agency. Accomplishing the actions identified in this plan will require developing many new partnerships, as well as continuing to capitalize on existing partnerships. Creation, testing, and implementation of market-based conservation tools are ongoing – greater emphasis on these approaches is also needed. While research and monitoring won't achieve conservation in and of itself, conducting research to understand the limiting factors SGCN face is necessary to accurately identify and prioritize specific management/conservation actions needed. For descriptions of the conservation actions referenced in the figures below, refer to Chapter 4 and Table 6.

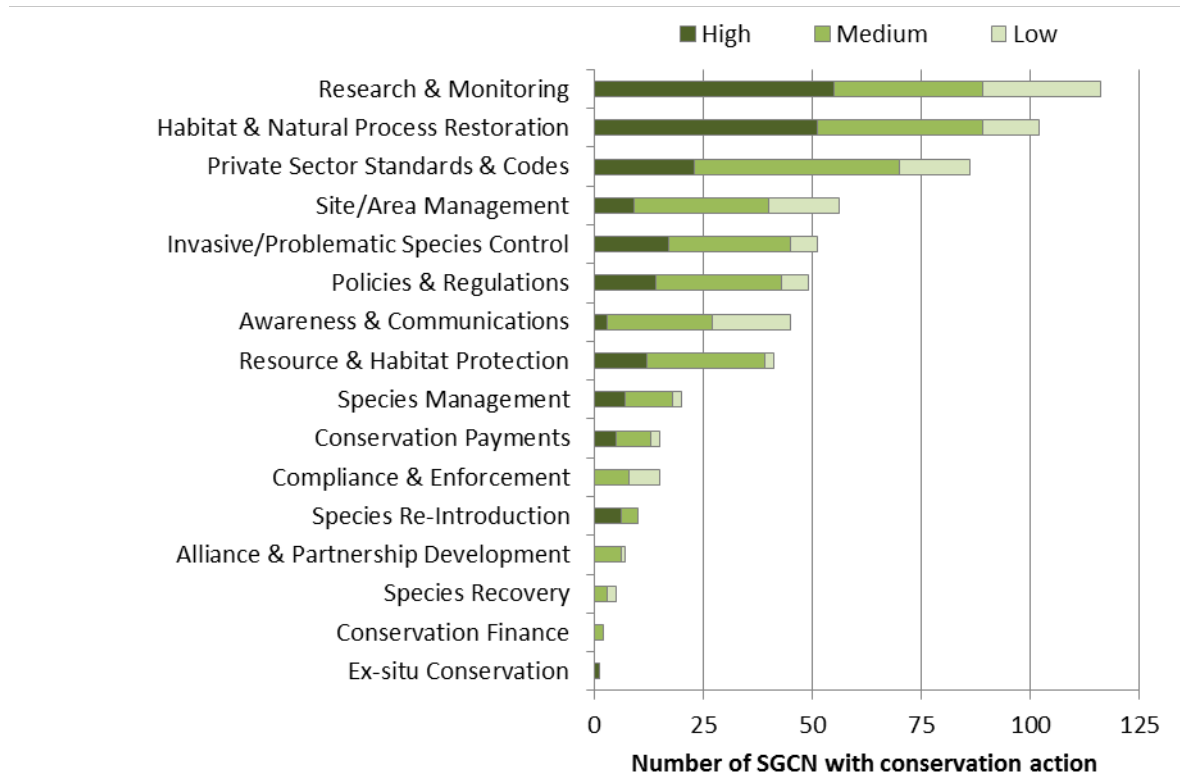


Figure 6. Conservation actions needed for vertebrate and mollusk SGCN by priority.

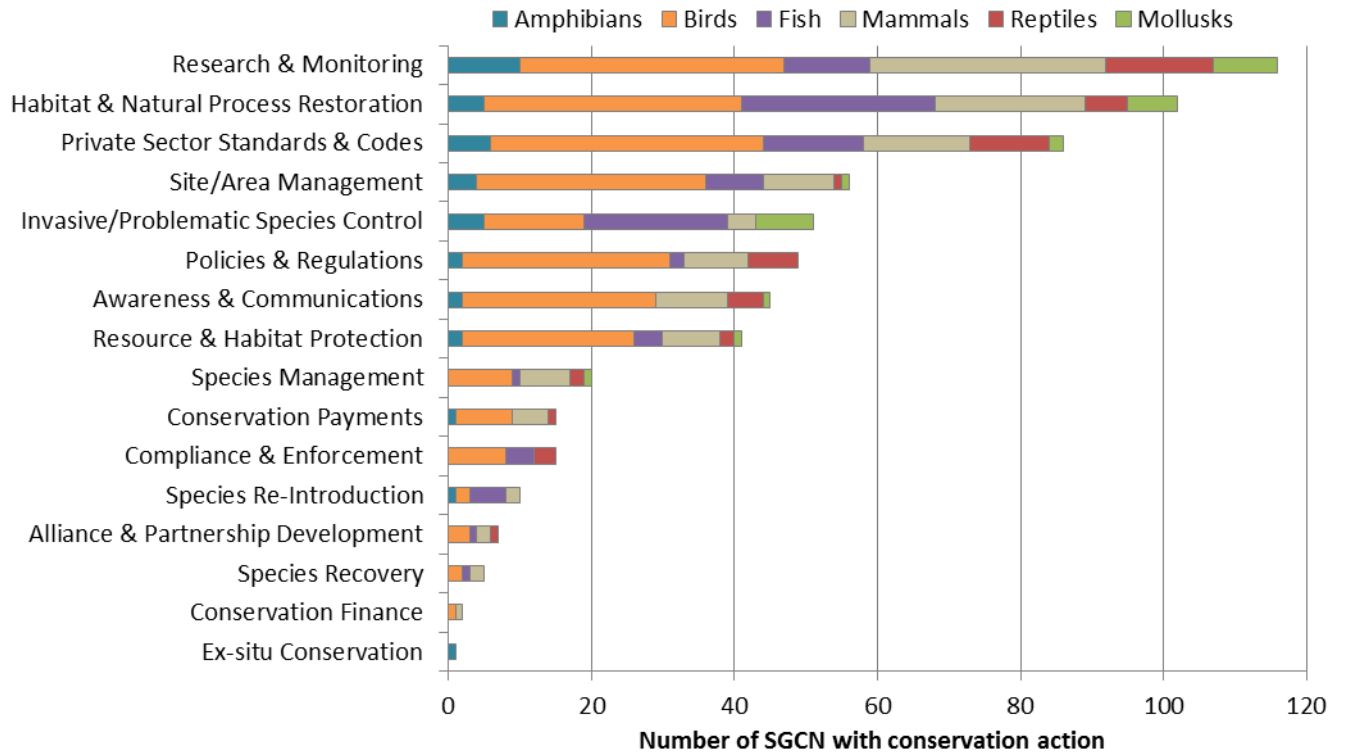


Figure 7. Conservation actions needed for vertebrate and mollusk SGCN by taxonomic group.

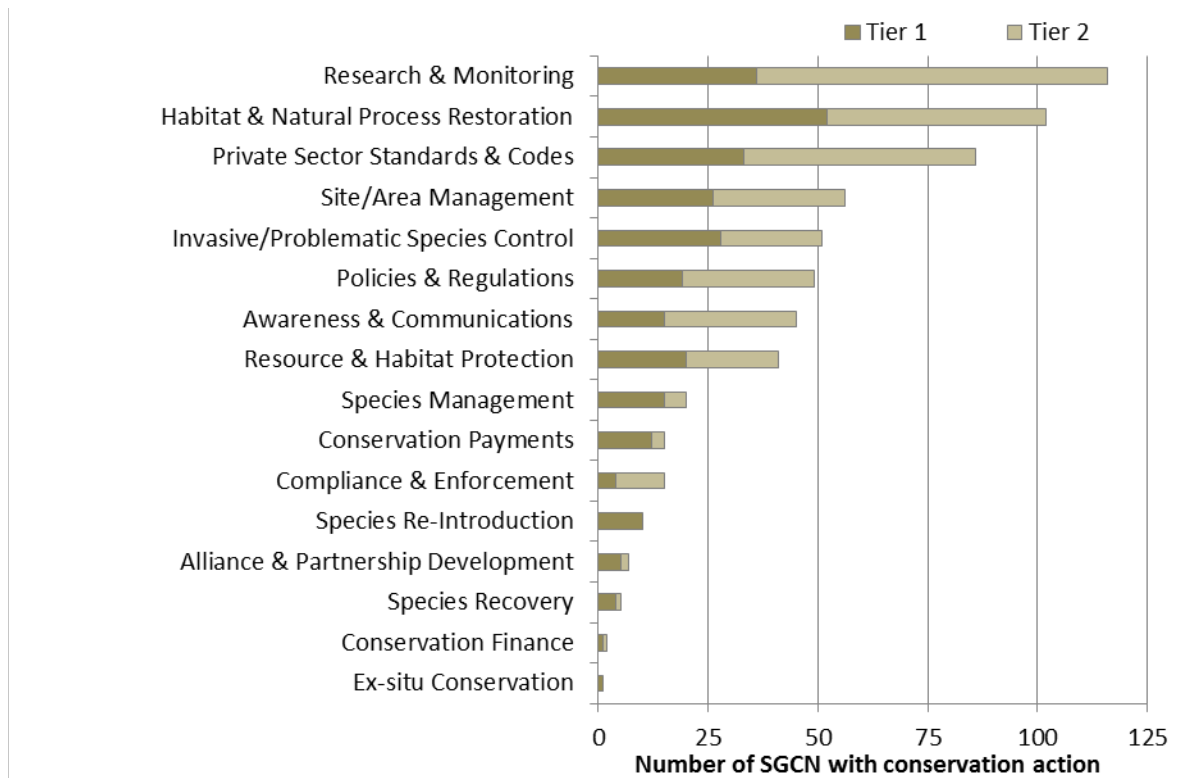


Figure 8. Conservation actions needed for vertebrate and mollusk SGCN by Tier.

Threats & Actions Narratives for Tier 1 SGCN

As previously noted, there are a number of resources that explore threats to SGCN and conservation actions needed in considerable detail. These include existing conservation assessments, management or recovery plans, and published research results. For the purposes of the SWAP, the highest priority threats and conservation actions for Tier 1 SGCN are briefly summarized in the following narratives. Table 7 presents status and trend, habitats and distribution, threats, and prioritized conservation actions for all vertebrate and mollusk Tier 1 and Tier 2 SGCN. Refer to Appendix D for a list of management and recovery plans that provide additional information on threats, recommended or proposed conservation/management actions, and research needs for specific species. See Appendix E for a key to the distribution field.

In the following species summaries, threats are addressed in the order in which they appear in the Salafsky lexicon (described in Chapter 4).

TIER 1 AMPHIBIANS

Boreal Toad (*Anaxyrus boreas boreas*)

For detailed information on threats and conservation actions needed for this species, refer to the 2001 Conservation Plan and Agreement for the management and recovery of the Southern Rocky Mountain population of the Boreal Toad (*Bufo boreas boreas*) and the 2005 technical conservation assessment (links in Appendix D).

Threats

7 Natural Systems Modification

The loss of riparian zone cottonwood and aspen due to the encroachment of coniferous forest from natural forest succession has been identified as a threat to some boreal toad breeding habitat. The loss of cottonwoods and aspen causes beavers to shift to willow/shrub vegetation for dam construction, leaving dams more likely to blow out during flooding or runoff, increasing the risk of drying for associated wetlands. Boreal toad breeding ponds are commonly found in beaver pond complexes (Holland 2002).

8 Invasives, Problematic Native Species, & Pathogens

The primary threat to boreal toad populations is from a pathogenic chytrid fungus (*Batrachochytrium dendrobatidis*; Bd). Many amphibian declines and extinctions have been associated worldwide with amphibian chytridiomycosis caused by Bd infections (Berger et al.

1998; Green and Kagarise-Sherman 2001; Daszak et al. 2003). Bd is evidently native in many parts of the world, but genetic evidence indicates that one or more hypervirulent strains emerged recently from recombination of formerly geographically isolated lineages, likely the result of an increased worldwide trade in amphibians (Farrer et al. 2011). In Colorado, Bd has been implicated in dramatic declines in several populations of boreal toads since its discovery in the state in 1999 (Loeffler 2001). Bd infection is lethal to boreal toads (Carey et al. 2006) and directly impacts survival (Muths et al. 2003; Scherer et al. 2005; Pilliod et al. 2010). Carey (1993) developed a hypothesis that potential environmental stressors were leading to immunosuppression in boreal toads, causing them to be more susceptible to disease.

11 Climate Change & Severe Weather

The predicted effects of climate change in the west include reduced snowpack and shorter periods of snow cover, snowmelt that occurs earlier in the season, a hydrologic cycle that is more dynamic as extreme rainfall events occur with greater frequency, and an overall warmer, drier, and more drought-like conditions (Melillo 2014). Climate change has the potential to alter the timing of pond breeding amphibians (Blaustein et al. 2001). Changes in snowpack could impact survival and breeding success of boreal toads (Corn 2003; Scherer et al. 2008).

Other Threats

Degradation of breeding habitat from activities such as recreation (Campbell 1970), grazing (Bartelt 1998), and sedimentation due to road sanding runoff can contribute to direct mortality of adults and juveniles. Large scale wetland alterations such as reservoir construction can eliminate breeding habitat causing population declines (Hammerson 1999). Direct mortality from vehicle collisions on busy roads has been documented and can cause significant losses if near a breeding site where toads congregate in large numbers.

Information Needs

Further research is required on the ecology of the chytrid fungus (*Batrachochytrium dendrobatidis*), including how it is spread, factors that make boreal toads susceptible to lethal infection, and environmental testing methods. Research is also needed on factors that potentially confer Bd resistance, including skin microbial community composition, particular habitat or behavioral characteristics, and possibly a genetic basis for a degree of Bd resistance.

Conservation Actions

Accelerate the pace of re-introductions and translocations to establish additional populations within the species' native range. Rigorously assess factors affecting translocation success, to increase success of future efforts. Continue survey efforts to identify additional populations. Identify habitat protective actions effective at preventing Bd invasion, and implement such measures where feasible. Continue to support research on Bd resistance and Bd transmission.

Northern Leopard Frog (*Lithobates pipiens*)

For detailed information on threats and conservation actions needed for this species, refer to the 2007 technical conservation assessment (link in Appendix D).

Threats

1 Residential & Commercial Development

The loss of wetland habitat is believed to be one of the causes of northern leopard frog declines in Washington, Oregon, Idaho and Montana (Koch et al. 1996). Urban development was consistent with observed regional declines in eastern Colorado (Johnson et al. 2011). Northern leopard frogs depend on a variety of habitat types: breeding ponds, midsummer foraging habitat, and suitable water bodies for overwintering (Merrell 1977), so are at risk of habitat fragmentation. Impairment of movement between these critical habitats could be a major threat to the persistence of local populations (Pope et al. 2000). Leopard frogs are also highly vulnerable to road mortality (Bouchard et al. 2009).

8 Invasives, Problematic Native Species, & Pathogens

The introduction of bullfrogs in western United States has been linked to northern leopard frog declines (Lannoo et al. 1994; Koch et al. 1996; Livo et al. 1998; Hammerson 1999; Johnson et al. 2011). Localized declines in Boulder County, Colorado, were attributed to a bullfrog introduction (Hammerson 1982). Typical northern leopard frog breeding habitat is devoid of predaceous fish (Merrell 1977), which makes them susceptible to introduced game fish.

The pathogenic chytrid fungus (*Batrachochytrium dendrobatidis*) has been implicated in amphibian declines around the world (Berger et al. 1998; Daszak et al. 2003). Chytrid fungus has been documented in Colorado populations of northern leopard frogs (Muths et al. 2003; Livo 2004; Johnson 2011).

11 Climate Change & Severe Weather

The predicted effects of climate change in the West include reduced snowpack and shorter periods of snow cover, snowmelt that occurs earlier in the season, a hydrologic cycle that is more dynamic as extreme rainfall events occur with greater frequency, and overall warmer, drier, and more drought-like conditions (Melillo 2014). Climate change has the potential to alter the timing of pond breeding amphibians (Blaustein et al. 2001) and changes in snowpack could also impact amphibians (Corn 2003). Drought was implicated in the extirpation of six populations in Larimer County, Colorado (Corn and Fogleman 1984).

Information Needs

Further research is required on the ecology of the chytrid fungus (*Batrachochytrium dendrobatidis*) and the susceptibility of northern leopard frogs to this pathogen. Information is also needed on the chytrid fungus status of northern leopard frog populations in Colorado. Effective control methods for non-native bullfrogs are needed, as are inventory to identify occupied wetland habitats to guide protection of wetland habitats for this species.

Conservation Actions

Protection of wetland habitat, e.g., through easements and other landowner agreements, is a key priority, particularly on the Front Range. Wetland areas that remain uninvaded by bullfrogs and other exotic amphibians are especially important. Identify opportunities to create or restore additional suitable habitat. Continue to support research on Bd resistance and Bd transmission. Carefully evaluate agency and private fish stocking locations to minimize impacts on northern leopard frog and other native amphibians.

TIER 1 BIRDS

Brown-capped Rosy-Finch (*Leucosticte australis*)

Threats

2 Incompatible Agriculture

Grazing by sheep may have a negative effect on brown-capped rosy-finches at wintering sites if they trample vegetation and disturb seed availability in arid shrublands.

6 Human Intrusions & Disturbance

In Colorado, the brown-capped rosy-finch breeds in alpine environments that occur predominantly on U.S. Forest Service land, with many acres designated as wilderness and in national parks. The brown-capped rosy finch remains at high elevations throughout the year unless severe storm events push them down to lower elevations in the winter months (Johnson et al. 2000). During the breeding season, populations are distant from most human activities and are relatively isolated from threats, but in winter they may be impacted by human activities as they drop to lower elevations to forage and roost. As access and participation in recreational activities in the alpine environment increases, recreation may have an impact on this species. Disturbance to nest sites could occur from recreational activities such as hiking, spring skiing, or rock climbing (Johnson et al. 2000).

11 Climate Change & Severe Weather

The brown-capped rosy finch breeds above treeline in Colorado where it can find suitable nest sites in steep cliff faces overlooking the alpine tundra (Johnson et al. 2000). During the breeding

season, this species forages on and at the edges of snowfields and glaciers where insects and seeds are deposited and in fell fields, cliffs, and rock slides (Kingery 1998; Johnson et al. 2000). The brown-capped rosy finch is thought to be susceptible to climate change due to the potential depletion of late lying snowfields as temperatures increase and winter precipitation patterns change. Though it is unknown if brown-capped rosy finches are dependent on snowfields, they do provide access to an abundant food source as insects are trapped there when wind updrafts are cutoff and insects fall stunned to the snow surface (Kingery 1998). Breeding success could be impacted if summer monsoonal moisture patterns change, resulting in alterations in the alpine plant communities that affect insect abundance and seed availability. If severity of winter storms intensify and increase, causing birds to migrate more frequently, winter mortality could also be impacted by climate change.

Information Needs

Information regarding population abundance and trends at both local and statewide levels is needed to better assess this species' status. Declining population trends have been shown for this species using Christmas Bird Count Data (Johnson et al. 2000), but these data may not provide an accurate assessment of the species since winter populations are eruptive and nomadic. The development of a statewide status assessment and monitoring program is therefore needed to determine if a downward trend is occurring, and what mechanism is driving this cycle. Potential threats at both summer breeding and wintering sites needs to be investigated to gain an understanding of potential impacts to populations.

Conservation Actions

Develop techniques to assess the population status and develop a long-term monitoring program to evaluate changes in populations and distribution in the face of climate change are also needed. Secure habitats and protect them from potential detrimental anthropogenic effects to provide a buffer for any effects due to climate change.

Burrowing Owl (*Athene cunicularia*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Western Grasslands Initiative – a Plan for Conserving Grassland Habitat and Wildlife (2011); Burrowing Owl (*Athene cunicularia*): a technical conservation assessment (2004); Conservation Plan for Grassland Species in Colorado (2003); Status Assessment and Conservation Plan for Western Burrowing Owl in the United States (2003) (links in Appendix D).

Threats

1 Residential & Commercial Development

The burrowing owl is closely associated with prairie dog colonies, and therefore is affected, directly or indirectly, by issues that threaten prairie dogs. Burrowing owl habitat has decreased in area and become fragmented as prairie dog colonies have been eradicated or gone extinct (McDonald et al. 2004). Prairie dog colonies have been converted to residential and commercial development and cropland across much of their range.

2 Incompatible Agriculture

In addition to habitat conversion, agricultural activities increase owl mortality and loss of prey through use of insecticides and pesticides, which jeopardize the health and stability of owl populations (Klute et al. 2003; Gervais et al. 2006). Intentional eradication of prairie dog colonies for agricultural purposes also directly affects burrowing owls.

5 Biological Resource Use

Recreational shooting of prairie dogs can decrease owl fecundity (Woodward 2002) or cause direct mortality when owls are mistaken for prairie dogs (Butts 1973). Seasonal shooting closures have been implemented on public land to help conservation of prairie dog populations.

8 Invasives, Problematic Native Species, & Pathogens

Prairie dog colonies have undergone dramatic collapses from sylvatic plague and eradication efforts, which has led to decreases in abundance of burrowing owls (Desmond et al. 2000).

Information Needs

Some of the greatest influences on burrowing owl population demographics (adult and first-year survival) may be driven by conditions or impacts at wintering grounds in Mexico. Determining what factors are controlling population stability on wintering grounds may provide needed information for effective conservation.

Conservation Actions

Conservation of burrowing owls hinges on the protection of healthy prairie dog colonies. Direct loss of prairie dog colonies through anthropogenic alternation (e.g., exurban development, energy development, poisoning) should be addressed through outreach to appropriate audiences, implementation of best management practices, securing of conservation easements and other habitat protections, and, when appropriate, use of zoning and other regulatory mechanisms to protect habitat. Indirect loss of prairie dog colonies due to sylvatic plague may be reduced through the development and use of vaccines to protect prairie dogs. The negative effects of sylvatic plague on burrowing owls may also be addressed by the conservation of large numbers or well-dispersed prairie dog colonies at landscape scales.

Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*): a technical conservation assessment (2007); Columbian Sharp-tailed Grouse Conservation Plan, Routt, Moffat, and Rio Blanco Counties, Northwest Colorado (2001) (links in Appendix D).

Threats

1 Residential & Commercial Development

Urbanization leads to fragmentation and the loss of native cover at lek sites, nesting and brooding areas, and winter habitat, rendering urban landscapes unsuitable for Columbian sharp-tailed grouse (Hoffman 2001). Hoffman (2001) states that the greatest threat of urbanization in northwestern Colorado is in Routt County, within a 20 mile (32 kilometer) radius of Steamboat Springs. Continuously balancing future residential and commercial development with conservation of Columbian sharp-tailed grouse habitat is necessary to prevent the decline of this species in Colorado.

2 Incompatible Agriculture

Cropland

Conversion of native cover to pasture and cropland in the past has resulted in dramatic decline of grouse populations. Healthy grouse populations require large, undisturbed, natural habitats with intact ecological functions, including natural disturbance regimes (Storch 2000). However, Columbian sharp-tailed grouse do use Conservation Reserve Program (CRP) fields, mine reclamation lands, and occasionally grain fields. Though sharp-tailed grouse are considered moderately tolerant of habitat change (Hoffman and Thomas 2007), they cannot persist on overly modified landscapes or in small, isolated native habitats. Within the current Colorado range of the Columbian sharp-tailed grouse, the conversion of native cover to cropland has run its course, with little conversion of native habitats currently taking place. In northwestern Colorado, where Columbian sharp-tailed grouse still persist, it is because these areas were unsuitable for crops and native cover suitable for grouse was left undisturbed (Hoffman 2001). Historically Columbian sharp-tailed grouse ranged across southwestern Colorado, but conversion of native cover to cropland extirpated grouse from this portion of their native range (Oyler-McCance et al. 2001). The loss of habitat to cropland has been reversed to some extent in Colorado by recovery of previously converted wheat acreage to CRP lands. In Colorado, preventing future loss of grouse habitat to agricultural uses and encouraging the placement of current croplands into the CRP will benefit Columbian sharp-tailed grouse.

Grazing

Private lands supply 71% of the Columbian sharp-tailed grouse habitat in northwestern Colorado (Hoffman 2001). Grazing in a manner that is incompatible with sharp-tailed grouse reduces or eliminates key food plants and the abundance of insects important to the growth and development of chicks, and increases predation rates by reducing cover needed for concealment from predators (Baines 1996; Hoffman and Thomas 2007). Use of herbicides to remove shrubs and create grassland for cattle is detrimental to sharp-tailed grouse, which require adequate shrub cover for nesting and overwintering. Consequently, incompatibly grazed habitat supports fewer leks, fewer males at leks, and smaller populations (Hoffman 2001; Flanders-Wanner et al. 2004). Alternately, compatible livestock grazing management can maintain and/or enhance habitat by promoting desirable plant communities, preventing weed encroachment, providing residual cover, and increasing plant diversity (Hoffman 2001). Compatible grazing on rangelands is based on controlling the intensity, timing, frequency, selectivity, and distribution of grazing animals (MWCC 1999). The use of sound grazing management practices within sharp-tailed grouse habitats will help prevent declines and could increase Columbian sharp-tailed grouse populations in Colorado.

Herbicide Use

In Colorado, herbicide use is more problematic to sharp-tailed grouse than the use of pesticides (Hoffman and Thomas 2007). The impacts of herbicide use include modification of habitat components required for both cover and food, which can cause increased levels of predation and starvation (Hoffman 2001). Consequently, managing herbicide use in grouse habitat will benefit Colorado sharp-tailed grouse.

Loss of Conservation Reserve Program (CRP) Lands

Within the Colorado range of the Columbian sharp-tailed grouse, there are 21,000 acres of CRP land. Approximately 21% of all known leks occur on these CRP lands, which also provide critical nesting and brood-rearing habitat. If these CRP lands are lost, sharp-tailed grouse populations will decline (Hoffman and Thomas 2007). Lands are enlisted in the CRP for 10 to 15 years. A concerted effort should be made to re-enlist lands whose contracts are expiring, and to enlist new lands into the program within the Colorado range of the Columbian sharp-tailed grouse. This is particularly true for CRP lands in the vicinity of Steamboat Springs, Colorado, where land values for urban development are high (Hoffman and Thomas 2007).

Degradation of Wetlands

Columbian sharp-tailed grouse are attracted to wetlands for the succulent vegetation as well as the abundance of invertebrates, which are an important nutritional resource for growing chicks (Hoffman 2001). In Colorado, wetlands within the range of sharp-tailed grouse have been converted to cropland and have suffered damage to wetland vegetation due to incompatible grazing by livestock (Hoffman 2001). Protecting the remaining wetland habitats within their current range will benefit Columbian sharp-tailed grouse.

3 Energy Production & Mining

The Rocky Mountain west is an important oil and gas producing region in the United States. Since the early 2000s, oil and gas development within the area occupied by the Columbian sharp-tailed grouse in northwestern Colorado has increased dramatically. According to GIS data from the Colorado Oil and Gas Conservation Commission, as of October 2014 there are over 1,300 oil and gas wells currently permitted or drilled within habitat of the Columbian sharp-tailed grouse in Colorado (<http://cogcc.state.co.us/>). Traffic and infrastructure from energy development, including roads, pads, tanks, utility lines and buildings, stresses sharp-tailed grouse populations, and leads to fragmentation and loss of native cover. Ultimately, this negatively impacts lek sites, nesting and brooding areas, and winter habitat, rendering them marginal for the Columbian sharp-tailed grouse (Hoffman and Thomas. 2007).

7 Natural System Modifications

Historically, fire was the major disturbance factor in sagebrush and mountain shrub biomes occupied by Columbian sharp-tailed grouse (Hoffman and Thomas 2007). A lack of fire in sharp-tailed grouse habitat is the most significant problem in Colorado (Hoffman and Thomas 2007). Within the range of sharp-tailed grouse, fire frequency has been altered over the past 150 years due to the introduction of both livestock and noxious weeds. Cattle remove vegetation, thereby reducing fuel loads. Reduction of fuel loads, combined with the fire suppression practiced in the west for the past century, has reduced the frequency of fires. In Colorado, lack of fire is the main problem for grouse, where large acreages of Gambel's oak, which sharp-tailed grouse don't use, have become decadent and overgrown, crowding out other more suitable xeric mountain shrubs (Connelly et al. 2004). Fire management that restored openings and species diversity in the shrub community would benefit sharp-tailed grouse in Colorado. Caution in use of fire as a management tool is recommended, however, because sagebrush does not recover quickly from fire, and can be eliminated by intense, frequent fires (Hoffman 2001).

8 Invasives, Problematic Native Species, & Pathogens

Grazing by wild ungulates may also negatively impact sharp-tailed grouse populations. When significant amounts of privately-owned land are closed to hunting and native predators are controlled, populations of native grazers (particularly elk) increase due to lack of both hunter and predator take. The result is that the ground and shrub cover required by grouse are diminished by elk browsing. Grazing by elk has increased in sagebrush and on CRP lands for these reasons (Hoffman and Thomas 2007). Efforts to meet elk management goals through enhanced harvest by hunters would benefit sharp-tailed grouse populations.

11 Climate Change & Severe Weather

Predicted changes in climate suggest that the West will experience an increase in temperature, a decrease in frosts, and increases in precipitation (Melillo et al. 2014). These changes are predicted to lead to an increase in conifers at the expense of shrublands, and an increase in fires

because of increasing fuel loads (Neilson et al. 2005). The effects of these changes, should they occur, is hard to predict, but incompatible management of sharp-tailed grouse habitat could intensify the adverse effects of climate change.

Information Needs

Research is currently underway on population demographics, chick and hen survival, and habitat use.

Conservation Actions

CPW recently embarked on a long term translocation program aimed at restoring Columbian sharp-tailed grouse to as much of their historic range as possible, according to the recently completed “Colorado Columbian Sharp-tailed Grouse Translocation Guidelines” (CPW 2014a).

Collaboration should be continued and expanded with Federal agency partners that manage lands occupied by Columbian sharp-tailed grouse, to ensure that grazing planning and practices acknowledge the importance of wildlife habitat and incorporate the needs of sharp-tailed grouse into grazing planning and prescriptions. Grazing should be prescribed to account for adequate nesting and brood rearing habitat for sharp-tailed grouse. Additionally, efforts should be undertaken to minimize the amount of undesirable woody encroachment into previously or currently occupied sharp-tailed grouse habitat. Suitable sharp-tailed grouse habitat needs are fairly well known, and can be generally characterized as diverse grassland/shrubland complexes with abundant forbs, adequate grass height, and limited or few trees. Rigorous assessments of habitat quality will dictate what management actions need to occur. Private lands provide a significant and important amount of habitat for Columbian sharp-tailed grouse, and interested partners, including CPW, need to be active in advocating for, and helping when necessary, in restoring disturbed private land habitat, including mine reclamation and CRP maintenance, establishment, and mid-contract management. CRP stands and seed mixes should include a diverse suite of beneficial forbs and legumes, including beneficial non-natives such as alfalfa where appropriate. Efforts to educate private landowners on the habitat needs of sharp-tailed grouse, and provide technical guidance and, if necessary, financial assistance to implement compatible grazing plans and/or to assist with the management of woody encroachment.

Golden Eagle (*Aquila chrysaetos*)

Threats

1 Residential & Commercial Development

The expansion of urban and exurban development has resulted in the loss of breeding habitat along Colorado's Front Range (Boeker 1974; Scott 1985). Along with urbanization comes increased recreational activity that can cause disturbance to golden eagles.

2 Incompatible Agriculture

Agricultural development can render areas once used as wintering habitat unsuitable for golden eagles (Craig et al. 1986).

3 Energy Production & Mining

Golden eagles are at greater risk to mortality from wind turbines than other raptors (USFWS 2011a), and they are also susceptible to death from collisions with cars, fences, and wires (Kochert et al. 2002). Additionally, disturbance from pre-construction, construction, or operation and maintenance activities at wind developments may disturb eagles at concentration sites, or result in loss of productivity at nearby nests, leading to permanent loss of nesting territory (USFWS 2013a). The U.S. Fish and Wildlife Service lists the following three factors as reasons for the increased risk of collision by eagles with wind turbines (USFWS 2011a):

- (1) topographic features, season, and wind currents interact to create favorable conditions for slope soaring or kiting (stationary or near-stationary hovering) in the vicinity of turbines;
- (2) behavior that distracts eagles and presumably makes them less vigilant (e.g., active foraging or inter- and intra-specific interactions); and
- (3) resident status, with resident adults and young less vulnerable and dispersers and migrants (especially sub-adults and floating adults) more vulnerable. This latter point should not be taken to undercut the potential severity of the risk to breeding adult eagles and their young, as losses from these segments of the population, especially breeding adults, can have serious consequences to populations.

5 Biological Resource Use

Golden eagles appear to be less susceptible to chemical pollution than other raptors (Kochert et al. 2002). However, secondary poisoning can occur when eagles consume carrion killed by herbicides, pesticides, rodenticides, and lead shot. Rodent control may also impact eagles by reducing abundance of prey species.

6 Human Intrusions & Disturbance

Human activity near nests can cause breeding failures, but most evidence is anecdotal or correlative (Kochert et al. 2002). Colorado Parks and Wildlife recommends no surface

occupancy within ¼ mile of active golden eagle nests beyond that which already occurs, as well as restriction of human activity to within ½ mile of active nests from December 15 through July 15 (CPW 2008). Additionally, researchers can cause disturbance at nests, resulting in nest abandonment, nest mortality due to excessive egg cooling or heating during periods when the researcher is at the nest and brooding adults are away, or cause young to fledge prematurely (Kochert et al. 2002). Such disturbance can be avoided if proper protocols and precautions are developed and followed by researchers.

7 Natural System Modifications

The recent increase in the incidence of catastrophic wildfire in the intermountain West, including Colorado, has the potential to disrupt the breeding biology of golden eagles. Nesting success at burned territories in Snake River Canyon, Idaho, declined after major fires, with abandoned territories being subsumed by neighboring pairs, resulting in a decreased number of nesting pairs (Kochert et al. 1999). Changes in precipitation and temperature predicted for the Rocky Mountain region over the next 50 years suggest the observed increase in wildfires recently witnessed in Colorado may persist (Westerling et al. 2006).

Information Needs

Monitoring is required to determine the population status in the western U.S., where declines in golden eagles is suspected (Kochert et al. 2002, but see Nielson et al. 2014). The factors that may be involved in these declines and factors responsible for population trends in general, including fire, are poorly understood and require further elucidation. Further information on how environmental pollutants and habitat alterations at both breeding and winter grounds affect populations is needed. Estimates of current population size and trends would be useful in assessing proposals to harvest eagles for use by Native American's in religious ceremonies.

Conservation Actions

Conduct research to better understand how golden eagles use space and interact with topography surrounding wind farms. Appropriate siting, micro-siting, and implementation of best management practices to mitigate effects of wind power development are also needed. Securing protection of large, unfragmented landscapes to alleviate habitat loss and degradation from oil and gas development, conversion to cropland, and other anthropogenic alterations is important for the conservation of stable golden eagle populations.

Greater Sage-grouse (*Centrocercus urophasianus*)

The information presented here is a very limited summary of the detailed threats and conservation actions described in the 2008 Colorado Greater Sage-grouse Conservation Plan, and should not be construed as a comprehensive or prioritized list of the threats. The Colorado

Conservation Plan (link in Appendix D) should be referenced in developing threat assessments and conservation interventions for the species. Note that the impacts of the threats described below are variable across the distribution of greater sage-grouse; some threats are less significant or non-existent in some populations.

Threats

1 Residential & Commercial Development

The primary cause of sage-grouse decline is the loss and fragmentation of sagebrush habitats (USFWS 2013e). Habitat has been lost and fragmented by suburban and rural development, agricultural conversion to cropland, intensive grazing pressure, alterations to fire regimes, and invasion of non-native annual grasses (Schroeder et al. 1999; Walker et al. 2007). Housing development and the associated infrastructure (e.g., roads, fencing, powerlines, increased human activity) results in permanent habitat loss, degradation, and fragmentation. Colorado's human population growth has resulted in conversion of agricultural lands to residential land uses, and impacts of development have spread onto nearby public lands.

2 Incompatible Agriculture

Grazing is one of the major land uses in sagebrush habitats, and has influenced sage-grouse habitat in a variety of ways, including removal of sagebrush from some areas, as well as alterations to understory plants needed for nesting, brood rearing, and other life history requirements. Direct and indirect impacts from improper grazing (grazing incompatible with local ecological conditions) on Greater Sage-grouse are uncertain and complex. However, grazing can also be used as a management tool to achieve desirable habitat conditions for the sage-grouse.

3 Energy Production & Mining

Habitat has been lost and fragmented by energy development and the associated infrastructure (e.g., powerlines, pipelines, and roads). In Colorado, there is considerable overlap in the potential for oil and gas drilling and oil shale extraction (CGSSC 2008). Also, the largest coal reserves in the state significantly overlap with Greater sage-grouse habitat. Demand for both oil and gas and coal is expected to remain high. Potential threats related to energy production and mining activities and infrastructure include reduction in amount of available habitat, fragmentation and degradation of remaining habitat, direct disturbance and/or mortality of individual birds, and increased predation. Increased human disturbance related to oil and gas development can also reduce viability of sage-grouse populations (Walker et al. 2007).

8 Invasives, Problematic Native Species, & Pathogens

Noxious and invasive weeds are considered a threat to rangeland health in much of greater sage-grouse habitat. Noxious weeds have the potential to degrade greater sage-grouse habitat,

primarily by increasing the fire regime frequency, decreasing plant diversity, and changing structure of plant and insect communities. A potentially significant issue for greater sage-grouse is the invasion of cheatgrass in the understory of sagebrush habitats. If cheatgrass out-competes native perennial plant species (which sage-grouse eat) to the point that the understory is comprised exclusively of annual grasses (which sage-grouse do not eat), value of the habitat could be significantly reduced. Juniper and pinion pine encroachment into sagebrush communities is occurring in some greater sage-grouse populations. Fire is important for suppressing expansion of pinion-juniper into shrub-steppe communities.

Information Needs

The Colorado Greater Sage-grouse Conservation Plan (CGSSC 2008) provides a detailed section on research needs related to greater sage-grouse. The section identifies detailed research topics that 1) are important to understanding greater sage-grouse populations and habitat; and 2) lead to more effective greater sage-grouse management. Some of the issues identified in the plan are listed below; see the plan for detailed, specific objectives and conservation strategies relates to each issue.

How greater sage-grouse population dynamics and sustainability are impacted by the quality and quantity of habitat and human-controlled activities in greater sage-grouse habitat is not well understood. The effectiveness of current measures designed to protect greater sage-grouse from impacts, specifically impacts of energy and mineral development, is unknown. The population-level impacts of predation, West Nile virus, and harvest are not well understood. There is also lack of information on invasive weed distribution in and the potential impact on greater sage-grouse habitat in Colorado.

Also, current methods for monitoring trends in greater sage-grouse populations and for estimating greater sage-grouse population size from lek counts make many unsupported assumptions. Research is needed to establish reliable and effective methods for monitoring greater sage-grouse population trends and estimating population size. CPW is currently undertaking this research.

Conservation Actions

The 2008 Colorado Greater Sage-grouse Conservation Plan provides comprehensive, detailed information and should be referenced in developing conservation actions for the species (link in Appendix D).

In this plan, each potential issue/threat has various objectives with corresponding conservation strategies. Each strategy has accompanying information regarding Responsible Parties, Timeline, and Cost. Because greater sage-grouse in Colorado are found in six separate populations, the potential threats and conservation strategies are diverse and complex. Existing local working

groups have developed local conservation plans. The statewide plan provides strategies for the cumulative, landscape-wide impacts to greater sage-grouse. Readers should consult and implement appropriate strategies within the statewide plan, and should also read and apply strategies with the applicable local plans. In some cases, more detail will be found in the local plans and in other cases, the statewide plan will be more specific.

Greater Sandhill Crane (*Grus canadensis tabida*)

Threats

2 Incompatible Agriculture

Staging areas

During migration, greater sandhill cranes feed primarily in agricultural fields. Changes in agricultural practices and the loss of farmland to the effects of climate change and urbanization all have the potential to impact populations of greater sandhill cranes in Colorado. Farming practices after harvest frequently determine the amount of waste seed available for sandhill cranes (Littlefield and Ivey 2002). In the San Luis Valley, spring food for cranes is becoming a critical issue as waste grain is being reduced by fall tilling and irrigation of fields after harvest (SRMGSC 2007). This process is used to stimulate sprouting and then freezing of waste seed after harvest, which leaves a clean field for spring planting.

Breeding Areas

Breeding sandhill cranes are dependent upon wet hay meadow and grain fields along the Yampa and Elk rivers in Routt County for foraging habitats (SRMGSC 2007). Cranes with broods prefer to forage in open, flooded meadows (Gerber et al. 2014). Frequently these sites are subject to agricultural practices that can be detrimental to nesting and fledging. Though meadows are generally good foraging sites for cranes, late June and July meadow mowing can kill crane chicks as they hide in dense vegetation and remain motionless, waiting for the threat to pass (Littlefield and Ivey 1994). In addition, meadows are often dried in June for hay harvest, and early drying can result in the unavailability of invertebrate foods, sometimes contributing to chick starvation (Littlefield and Ivey 2002).

7 Natural System Modifications

Staging Areas

The single greatest threat to sandhill cranes appears to be loss of non-breeding habitat; particularly fall and spring staging areas in Colorado (Gerber et al. 2014). The major fall and spring migration stop for the Rocky Mountain population of the greater sandhill crane is in the San Luis Valley, Colorado. Most roosting areas are on the Monte Vista National Wildlife Refuge (NWR), Baca National Wildlife Area, Higel State Wildlife Area, Rio Grande State Wildlife Area,

the channel of the Rio Grande River, and private marshes and wet meadows along the river from the town of Monte Vista to the Alamosa NWR. Water withdrawal for urban and agricultural use, combined with climate change and drought, has lowered the water table in the San Luis Valley resulting in shrinking habitat for sandhill cranes (SRMGSC 2007). This loss of habitat has caused crowding leading to disease outbreaks. Consequently, avian tuberculosis, cholera, and botulism have caused crane mortality in staging areas in the San Luis Valley (Drewien et al. 2001).

Breeding Areas

Habitat loss within breeding areas is a serious threat to greater sandhill cranes in Colorado. Breeding cranes utilize the river valleys, marshes, and wet meadows of northern Colorado, where human populations are low but increasing. In Colorado, breeding sites are located on private lands that are desirable for exurban development (SRMGSC 2007).

Information Needs

Habitat inventories are needed to identify, classify, rank, and catalog habitats used by greater sandhill cranes in Colorado. This information will help facilitate the protection of important habitat through acquisition, easement, cooperative agreements, special-use permits, and mitigation exchanges and developments (SRMGSC 2007). Understanding how changing human impacts (including changes in agricultural practices induced by climate change) affect both breeding and non-breeding staging sites will be important for creating long-term conservation strategies (Gerber et al. 2014). Investigation of how changing agricultural practices are diminishing food availability in the San Luis Valley and the feasibility of augmenting food supplies by developing natural forage sites through wetland creation and enhancement is needed (SRMGSC 2007).

Conservation Actions

Conservation and appropriate management of important habitats is needed. In particular, maintaining or improving the health of riparian and wetland habitats, and ensuring adequate availability of food resources, is needed.

Gunnison Sage-grouse (*Centrocercus minimus*)

The information presented here is a very limited summary of the detailed threats and conservation actions described in the 2005 Gunnison Sage-grouse Rangewide Conservation Plan, and should not be construed as a comprehensive or prioritized list of the threats. The Rangewide Conservation Plan should be referenced in developing threat assessments and conservation interventions for the species (link in Appendix D). For additional information, refer also to the U.S. Fish and Wildlife Service's final listing decision (USFWS 2014a).

Note that the impacts of the threats described below are variable across the distribution of Gunnison sage-grouse; some threats are less significant for the Gunnison population compared with some satellite populations.

Threats

1 Residential & Commercial Development

As noted in the Rangewide Conservation Plan, if not managed properly, residential and commercial development and associated infrastructure (e.g., roads, power lines, reservoirs) have the potential to impact Gunnison sage-grouse habitat and populations. Current and future human population growth rates and patterns vary widely across the species' range, but are generally higher in low-elevation meadows, grasslands, and sagebrush. The impacts of residential and commercial development can be minimized by concentrating new growth in or near areas outside of occupied or suitable habitat. Gunnison County, where the majority of Gunnison sage-grouse are found, has successfully implemented land use regulations and voluntary conservation measures (including significant conservation easements) to avoid, minimize and/or mitigate potential adverse impacts of new construction in the county on the species. Development in the Gunnison Basin is currently considered by the United States Fish & Wildlife Service to be a threat of low magnitude to the persistence of the species. In the smaller satellite population areas, similar measures can aid in avoiding or minimizing the impacts of population growth on Gunnison sage-grouse habitat.

2 Incompatible Agriculture

In addition to habitat conversion to cropland, grazing (one of the major land uses in sagebrush habitats) has influenced sage-grouse habitat in a variety of ways. Direct and indirect impacts from improper grazing (grazing that is incompatible with local ecological conditions) on Gunnison sage-grouse are uncertain and complex. Potential impacts include removal of sagebrush from some areas, as well as alterations to understory plants needed for nesting, brood rearing, and other life history requirements. However, grazing can also be used as a management tool to achieve desirable habitat conditions for the grouse. Conservation measures from the Gunnison Basin Candidate Conservation Agreement (CCA) should continue to address potential impacts from livestock grazing and operations on Federal lands in the Gunnison Basin. Also, conservation measures within the Candidate Conservation Agreement with Assurances (CCAA) Program have minimized impacts from livestock grazing and operations on private lands across the range of Gunnison sage-grouse.

3 Energy Production & Mining

Current and potential leasable energy development is limited to a small portion of the species' overall range and to date, the majority of oil and gas development has occurred outside of occupied habitat for Gunnison sage-grouse. The San Miguel Basin and Dove Creek populations

are the only areas within Gunnison sage-grouse range that currently have a moderate amount of oil and gas production. There are no active coal operations in Gunnison sage-grouse habitat, and recoverable coal resources are limited in Gunnison sage-grouse range. Localized threats related to energy production and mining activities and infrastructure may include reduction in amount of available habitat, fragmentation and degradation of remaining habitat, direct disturbance and/or mortality of individual birds, and increased predation. These localized impacts, however, are not projected to pose a significant threat to the species.

Information Needs

The Gunnison Sage-grouse Rangewide Conservation Plan (2005) provides a detailed section on research needs related to Gunnison Sage-grouse. The section identifies broad research topics that 1) are important to understanding populations and habitat; and 2) lead to more effective management. The highest priority research need is to evaluate the effect of habitat quality and quantity on the behavior and population dynamics.

Conservation Actions

Again, the reader is referred to the Rangewide Conservation Plan in developing threat assessments and conservation interventions for the species (available online: <http://cpw.state.co.us/learn/Pages/GunnisonSagegrouseConservationPlan.aspx>).

Lesser Prairie-chicken (*Tympanuchus pallidicinctus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: The Lesser Prairie-chicken Range-wide Conservation Plan (2013); Lesser Prairie-chicken Conservation Initiative (2008); Lesser Prairie-chicken (*Tympanuchus pallidicinctus*): a technical conservation assessment (2005); Federal listing documents; Lesser Prairie-chicken Recovery Plan (1992) (links in Appendix D).

Threats

2 Incompatible Agriculture

Fragmentation, degradation, and conversion of grasslands has led to isolation and reduced viability of lesser prairie-chicken populations (Johnson et al. 2003; Silvy and Hagen 2004). In Colorado, a majority of the historically suitable habitat has been converted to croplands. The remaining landscape is sandy rangeland sites characterized by choppy or deep sands and sandsage. The primary limiting factor for lesser prairie-chicken populations in Colorado is the current lack of large continuous blocks of diverse grassland, approximately mid-calf to knee high, that contains abundant forbs, legumes and/or sandsage. This diverse grassland/forb/shrub community must provide the height and density that will provide adequate cover for nesting, brood-rearing, and year-round survival. This habitat has been dramatically altered by grazing

systems and management that have resulted in nearly complete loss of native mid-grass species which are critical for nesting. The majority of sandsage in Colorado is now dominated by shortgrass species, and/or has a dramatically reduced or eliminated grass component. Many of these habitats are lacking necessary components (e.g., adequate concealing cover for nesting, escape cover). Conservation Reserve Program fields contribute important habitat for lesser prairie-chickens. Loss of CRP fields and CRP fields planted with incompatible seed mixes exacerbate the degraded condition of available habitat.

3 Energy Production & Mining

Oil and gas development fragments habitat and leads to behavioral avoidance, including lek abandonment, in areas where production and related infrastructure occur (Van Pelt et al. 2013). Hunt (2004) found well densities higher near abandoned leks than near active leks. Increasing densities of oil and gas wells may result in reduced lesser prairie-chicken populations.

14 Natural Factors

Because lesser prairie-chickens have small home ranges and habitats are becoming more isolated and disjunct (Robb and Schroeder 2005), there is evidence of diminishing genetic diversity (Johnson et al. 2003, 2004). This can lead to appearance of deleterious recessive alleles, reduced reproductive output, and susceptibility to stochastic events.

Information Needs

Some basic rangewide natural history information is still lacking for the lesser prairie-chicken, including information on dispersal, recruitment, and the importance of parasites and infectious diseases. Also, information on local population size and the capacity for connectivity, as well as how habitat quality and patch size can mitigate mortality factors, is needed (Robb and Schroeder 2005). Research to better determine the direct and indirect effects of anthropogenic structures (e.g., oil and gas wells, wind turbines) is needed to implement the most effective mitigation programs. For restored grasslands, research to determine most effective seed mixes and planting techniques is needed, including how habitat responds to intentional occasional disturbance such as mid-contract management for CRP parcels.

Conservation Actions

Conservation of lesser prairie-chickens is dependent on the protection of large, unfragmented landscapes with suitable habitat. When possible, permanent conservation easements should be used to secure habitat in perpetuity. While permanent easements are preferable, term easements may have utility in some situations. Term length should be a minimum of 5-10 years, although longer is highly desirable. Programs that dis-incentivize the conversion of native habitats or planted grass cover to rowcrop production should be implemented. Negative effects from anthropogenic activities which cause habitat loss and fragmentation (oil and gas, wind power, electrical transmission) must be ameliorated through appropriate avoidance and minimization

and, when necessary, offsetting mitigation. Because of very low populations in Colorado, habitat protection and improvement around remaining leks is imperative and the possibility of population enhancement through translocations should be explored. Severe and long-term droughts have significant impacts on lesser prairie-chicken populations. While droughts themselves can not be prevented, providing sufficient high-quality habitat will allow the species to persist during such stressful periods.

In Colorado, sandsage rangelands and planted grass habitats (e.g., CRP) must be managed to provide habitat for lekking, nesting, and brood rearing. Landowner outreach, the Farm Bill, and other incentive programs (e.g., Lesser Prairie-chicken Rangewide Conservation Plan) should be used to encourage landowners to implement agricultural practices that are compatible with lesser prairie-chicken conservation. Cropland can be converted to suitable lesser prairie-chicken habitat using a diverse mix of plant species. The largest and most familiar program to do this is the Conservation Reserve Program.

The most limiting factor in the degree of suitability of currently enrolled CRP fields for lesser prairie-chicken in Colorado is the widespread use of an aggressive native grass, sideoats grama, which largely does not provide suitable lesser prairie-chicken habitat under current management regimes. This native species tends to out-compete other native grasses and necessary forbs and legumes in the highly disturbed system. Current CPW habitat use research using GPS radio telemetry is corroborating previous work from Kansas and abundant anecdotal evidence that the use of non-native but highly beneficial dryland adapted alfalfa in CRP plantings is providing habitat to lesser prairie-chickens in CRP dominated landscapes. CRP seed mixes must be designed so that the resulting habitat will address the structural and composition needs of lesser prairie-chickens.

Another factor limiting the potential for CRP to provide habitat is the declining national acreage cap, and the counties in southeastern Colorado often reach their allowable enrollment cap. However, establishing suitable habitat for lesser prairie-chickens through CRP or similar programs remains one of the quickest and most effective management actions to improve conditions for lesser prairie-chicken populations in Colorado.

Grazing management to ensure an adequate interspersed of habitat types and the mid-height warm season grasses and abundant forbs that are critical components of suitable lesser prairie-chicken habitat is needed. To be successful, this will require sound technical assistance, financial incentives, and landowner buy-in. Use of grazing management to improve habitat is on a much longer time frame than establishing adequate and suitable habitat on previously cropped acres through the CRP or similar programs. It is unknown how many years it will take to (or if it is even possible) to restore the most highly degraded sandsage areas to suitable habitat for lesser prairie-chickens.

Improving habitat conditions for lesser prairie-chickens in Colorado will require continued and improved commitment from a variety of government agencies and partners. Effective outreach will be necessary to engage private landowners in lesser prairie-chicken habitat efforts as the vast majority of potential habitat is on privately owned lands. Lastly, management actions must effectively incorporate scientific data and use sound techniques and methodology to recover or establish habitat that will directly address population limiting factors for lesser prairie-chickens.

Mountain Plover (*Charadrius montanus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Western Grasslands Initiative – a Plan for Conserving Grassland Habitat and Wildlife (2011); Conservation Plan for Grassland Species in Colorado (2003); Mountain Plover (*Charadrius montanus*): a technical conservation assessment (2003); Proposed federal listing documents (links in Appendix D).

Threats

1 Residential & Commercial Development

The major threat to the mountain plover is the loss of native habitats and the loss of those species that can create suitable habitat (especially prairie dogs) (Dinsmore 2003). In Colorado, residential and commercial development has replaced mountain plover habitat along the Front Range, in scattered locations throughout the eastern plains, and in South Park.

2 Incompatible Agriculture

Much mountain plover habitat in Colorado has been converted to cropland. Mountain plovers can adapt to changing landscapes by utilizing surrounding cropland for nesting. Though mountain plovers do use cropland, it may be less suitable in some areas (i.e., low chick survival rates) than shortgrass prairie or prairie dog towns (Dreitz 2008). As prairie dogs have undergone precipitous declines (Dreitz 2009), so have the bare-ground/shortgrass habitats that are ideal for mountain plover. Domestic livestock grazing has replaced the historic grazing regimes once found on the Great Plains, but livestock do not necessarily replicate grazed conditions necessary for plover nesting success. Instead, livestock often convert the mosaic of bare ground and vegetation structure favored by mountain plovers to more homogenous structure lacking the crucial bare ground component (Dinsmore 2003). Augustine and Derner (2012) suggest that prescribed burn and prairie dog grazing provide more suitable habitat on shortgrass prairie than intense livestock grazing alone.

3 Energy Production & Mining

Oil and gas development near suitable habitat may limit plover use of areas and may fragment contiguous patches of suitable habitat. This, in combination with the above threats, contribute to a landscape that has become more fragmented for plover habitat, reducing the size of viable patches, and possibly isolating some breeding or wintering populations. In addition, associated disturbances such as noise, presence of humans, and vehicle traffic may result in behavioral avoidance. However, because plovers are attracted to disturbed ground for nesting, oil and gas development activities may hinder some nesting, but they could also attract plovers. If nests are known to be in the area, efforts to avoid destruction should be made.

8 Invasives, Problematic Native Species, & Pathogens

Sylvatic plague is a significant threat to remaining prairie dog colonies, and mountain plovers are positively associated with prairie dog colonies. Addressing plague management would be a positive benefit to mountain plover conservation.

Information Needs

Precise rangewide and local population demographics information, including population size, is lacking for mountain plovers. There is a lack of understanding of how landscape management activities impact plover populations. Also, the movement patterns among and within regional populations is poorly understood. Lastly, knowledge of predator and prey communities and their dynamics at breeding and wintering grounds needs further study. It is possible the greatest threats to mountain plovers are not in Colorado on their breeding grounds, but rather on their wintering grounds, since research in Colorado shows significant use of fallow agricultural lands, which are abundant, for nesting habitat. Additional research is needed to determine what factors are limiting the population so that effective management can be implemented.

Conservation Actions

In Colorado, conservation and management of shortgrass prairie is necessary for maintenance of healthy mountain plover populations. Use of best management practices (for example, prescribed fire, promotion of prairie dog colonies) to limit impacts from energy development, cropland conversion, and exurban development should be encouraged. Landowner outreach and incentive programs through the Farm Bill or other programs can be used to encourage grazing practices that are compatible with mountain plovers. Because prairie dogs are important for creating short grassland habitats preferred by mountain plovers, conservation actions which benefit prairie dogs should be implemented. Direct loss of prairie dog colonies through anthropogenic alternation (e.g., exurban development, energy development, poisoning) should be addressed through outreach to appropriate audiences (including policy-makers and landowners), implementation of best management practices, securing of conservation easements and other habitat protections, and, when appropriate, use of zoning and other regulatory mechanisms to protect habitat. Indirect loss of prairie dog colonies due to sylvatic plague may be

reduced through the development and use of vaccines to protect prairie dogs. The negative effects of sylvatic plague on mountain plovers may also be addressed by the conservation of large numbers or well-dispersed prairie dog colonies at landscape scales.

Plains Sharp-tailed Grouse (*Tympanuchus phasianellus jamesi*)

Threats

1 Residential & Commercial Development

Plains sharp-tailed grouse in Colorado have been negatively impacted by residential and commercial development. Douglas County, one of the perennially fastest growing counties in the United States for a number of years, historically provided some of the best plains sharp-tailed grouse habitat in the state. This former stronghold does not currently, and likely never will, provide sharptail habitat due to habitat loss to residential development.

2 Incompatible Agriculture

Cropland

Conversion of native cover to pasture and cropland in the past has resulted in dramatic decline of grouse populations. Healthy grouse populations require large, undisturbed, natural habitats with intact ecological functions including natural disturbance regimes (Storch 2000). Historically, plains sharp-tailed grouse ranged across the northern two thirds of eastern Colorado, but conversion of native cover to cropland has extirpated plains sharp-tailed grouse from much of their native range. In Colorado, preventing future loss of habitat to agricultural uses and encouraging the enrollment of croplands into the CRP within the current range of plains sharp-tailed grouse will benefit this species.

Grazing

Private lands supply approximately 50 percent of the plains sharp-tailed grouse habitat in northeastern Colorado. Grazing that is incompatible with sharp-tailed grouse results in reduction or elimination of key grouse food plants and the abundance of insects important to the growth and development of chicks, and increases predation rates of adult and young grouse by reducing cover needed for concealment from predators (Baines 1996; Hoffman and Thomas 2007). Consequently, incompatibly grazed habitat supports fewer leks, fewer males at leks, and smaller populations of sharp-tailed grouse (Flanders-Wanner et al. 2004). Alternately, proper grazing management can maintain and/or enhance sharp-tailed grouse habitat by promoting desirable plant communities, preventing weed encroachment, providing residual cover, and increasing plant diversity (Hoffman 2001). Proper grazing management on rangelands is based on controlling the intensity, timing, frequency, selectivity and distribution of grazing animals (MWCC 1999). The use of sound grazing management practices within sharp-tailed grouse

habitats will help prevent declines and could increase plains sharp-tailed grouse populations in Colorado.

3 Energy Production & Mining

Oil and Gas

The Rocky Mountain west is an important oil and gas producing region in the United States. Since the early 2000s, oil and gas development within the area occupied by the plains sharp-tailed grouse in northeastern Colorado has increased dramatically. According to GIS data from the Colorado Oil and Gas Conservation Commission, as of October 2014 there are over 1,500 oil and gas wells currently permitted or drilled within habitat of the plains sharp-tailed grouse in Colorado (COGCC 2014). Traffic and infrastructure from energy development, including roads, pads, tanks, utility lines and buildings, stress sharp-tailed grouse populations and lead to fragmentation and the loss of native cover. Ultimately, this negatively impacts lek sites, nesting and brooding areas, and winter habitat, rendering them marginal for sharp-tailed grouse (Hoffman and Thomas 2007).

Renewable Energy

There are four large scale wind farms within the range of the plains sharp-tailed grouse in Colorado, with potential for more development in the future (NRDC 2014). No research has been conducted on the impacts that wind turbines and other infrastructure (e.g., transmission lines) have on plains sharp-tailed grouse, but concerns include noise, habitat disruption, disturbance, fragmentation, and increased predator access (USFWS 2004; UWIN 2010). Pruet et al. (2009) demonstrated that greater prairie-chicken (*Tympanuchus cupido*) movements are altered by wind energy development; they avoid crossing under transmission lines and avoid activity near the tall structures associated with wind energy. However, it is unknown whether or not plains sharp-tailed grouse respond in a similar way. Sharp-tailed grouse tend to be fairly tolerant of limited development and disturbance, often using disturbed habitat such as homesteads, tree rows, and agricultural fields at certain times of year. Given the uncertainties surrounding the impacts of wind energy development on prairie grouse, the USFWS (2004) recommends restricting installation of wind turbines or wind facilities within a 5-mile radius of active grouse leks.

Information Needs

Knowledge of plains sharp-tailed grouse biology in Colorado is limited. Research is needed on the effects of grazing practices on sharp-tailed grouse habitat, and on the minimum habitat patch size needed to support stable populations of sharp-tailed grouse (Braun et al. 1992). The spatial configuration of habitat suitable for prairie grouse may become critical if the amount of available habitat drops below a threshold. Consequently, information on the spatial description of habitat requirements is needed, particularly in areas that may be fragmented by cropland and energy development (Niemuth 2011).

Conservation Actions

Effective conservation of remaining plains sharp-tailed grouse populations in Colorado rest largely with maintaining suitable habitat on previously cropped lands enrolled into the Conservation Reserve Program. Suitable habitat complexes of CRP, limited amounts of dryland agriculture in cereal grains, and native range exhibiting and maintaining a mid-grass and/or native shrub component will be necessary to sustain plains sharp-tailed grouse. Grazing management can be improved adjacent to CRP, but the existing rangeland where sharp-tailed grouse still occur is marginal at best, and this species is now exceedingly reliant upon suitable CRP, as the best of their historic range in Colorado has been permanently lost.

Southern White-tailed Ptarmigan (*Lagopus leucura altipetens*)

For detailed information on threats and conservation actions needed for this subspecies, refer to the following resources: White-tailed Ptarmigan (*Lagopus leucura*): a technical conservation assessment (2006) (link in Appendix D).

Threats

2 Incompatible Agriculture

Grazing in the alpine environment by livestock, mostly sheep, may have a negative effect on white-tailed ptarmigan populations due to alterations in the alpine plant community as well as disturbance to willow carrs. Studies have shown that sheep grazing in the alpine reduces cover of some important food sources for ptarmigan (Hoffman 2006 and references therein).

6 Human Intrusions & Disturbance

Recreation in alpine areas has increased over the past few decades and will likely continue to increase. Recreational activities include skiing, hiking with dogs, all-terrain vehicle use, and snowmobiling, all of which have the potential to disturb white-tailed ptarmigan populations and/or degrade habitat.

8 Invasives, Problematic Native Species, & Pathogens

Expansion of wild ungulates, primarily elk but also mountain goats and moose, into alpine habitat may negatively affect white-tailed ptarmigan populations (Hoffman 2006). Elk grazing and browsing in the alpine & subalpine willow habitat of some areas (e.g., Rocky Mountain National Park) may result in reduced suitability for ptarmigan. Degradation of willow in alpine and subalpine habitats by elk could impact ptarmigans on wintering areas by reducing survival and lowering body condition.

11 Climate Change & Severe Weather

White-tailed ptarmigan are an alpine species that depend on willows in the winter months to survive and lush alpine vegetation in the summer to breed and fledge young. There is concern that the species will be negatively impacted by climate change. Changes that could impact the species in Colorado are loss of willow carrs due to drying and degradation, increases in thaw/melt cycles in winter that limit roosting sites, changes in summer monsoonal patterns that result in warmer summer temperatures and less precipitation to maintain productive vegetation in alpine systems, increases in and severity of spring storms when young chicks are vulnerable, increase in predators not normally occurring at higher elevations due to warming trends, and potentially increases in avian diseases.

Ptarmigan are not well-adapted physiologically for dealing with high temperatures (Johnson 1968). Wang et al. (2002), in their study of white-tailed ptarmigan in Rocky Mountain National Park, found that over 25 years the average median hatch date has advanced 15 days, and that winter temperatures may have contributed to this species' long-term decline.

Information Needs

Continued monitoring of the species is needed to evaluate how it may respond to changing environmental conditions brought about by climate change. Recent research has provided reliable estimates of statewide survival and abundance (Seglund 2011; Seglund and Street 2013). Continuing this work is needed to test trends in survival, reproductive success, and population size.

Conservation Actions

In 2010, the southern white-tailed ptarmigan was petitioned to be listed as threatened under the Endangered Species Act. Colorado supports the largest population of southern white-tailed ptarmigan in the lower 48 states. Thus, if the subspecies does become listed, CPW will be responsible for the bulk of the protection and management of the species. Therefore, continued long-term monitoring using enhanced models to monitor range-wide trends in distribution and evaluate population status is needed. Coordination among agencies would help in these efforts.

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Final Recovery Plan Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (2002); Federal listing documents (links in Appendix D).

Threats

2 Incompatible Agriculture

Incompatible grazing by livestock in riparian habitat has resulted in the loss of riparian vegetation, particularly within the arid west (Belsky et al. 1999). Incompatible grazing in riparian areas can reduce the overall density of vegetation, which is a primary attribute of southwestern willow flycatcher breeding habitat (USFWS 2002a). Related impacts may include soil compaction, increased runoff leading to gulying, downcutting, and a lowered water table, subsequently furthering the loss of riparian vegetation. Livestock can also directly destroy willow flycatcher nests (Valentine et al. 1988). In the arid mountain regions of the west, water resources and fertile land suitable to support cropland exists mainly along streams where water for irrigation and rich soils deposited on stream floodplains is found. These areas that once contained extensive riparian habitat suitable for willow flycatchers have been converted to agriculture (USFWS 2002a). Farming operations can also create habitat for brown-headed cowbirds (*Molothrus ater*) by creating short-grass fields, grain storage and livestock concentrations in proximity to willow flycatcher nesting habitat (USFWS 2002a).

7 Natural System Modifications

The riparian habitat the southwestern willow flycatcher depends on has been disturbed by multiple human-induced activities, including reductions in water flow, interruptions in natural hydrological events and cycles, physical modifications to streams, modification of native plant communities by invasion of exotic species, and direct removal of riparian vegetation (USFWS 2002a). Streams occupied by the flycatcher have been disturbed by impoundments, dams, and reservoirs that alter the timing, frequency and quantity of flows, which in turn adversely impact riparian vegetation, rendering it unsuitable for willow flycatchers. Water diversion and groundwater pumping have dried riparian zones, leading to the loss of riparian shrubs necessary for willow flycatchers. Channelization, bank stabilization, levees, and other forms of flow controls have separated streams from their floodplains, reducing the cover of wooded riparian habitats willow flycatchers are dependent upon.

Fire within riparian habitats can be particularly damaging to riparian plant communities because they are not adapted to fire, nor are they fire regenerated. There is evidence that fire has increased in western riparian habitats where streams have been regulated because the reduction of flooding has allowed fuels to buildup, and because of the expansion and dominance of the highly-flammable tamarisk (Busch 1995). The loss of riparian habitat due to increased frequency of fire causes the direct loss of willow flycatcher habitat.

8 Invasives, Problematic Native Species, & Pathogens

Many waterways within the range of the southwestern willow flycatcher have been invaded by tamarisk (*Tamarix ramosissima*). Southwestern willow flycatchers will nest in some habitats that

have become invaded by, or have become dominated by, tamarisk (Paradzick et al. 2000). Consequently, the restoration of riparian habitat through the removal of tamarisk can pose a threat to southwestern willow flycatchers. When conducted in areas of suitable habitat (occupied or unoccupied), and when conducted in the absence of restoration plans to ensure replacement by vegetation of equal or higher functional value, the result can be a decline in willow flycatcher populations (USFWS 2002a).

14 Natural Factors

The southwestern willow flycatcher suffers brood parasitism from brown-headed cowbirds, which reduces reproductive performance (USFWS 2002a). Under normal conditions, brood parasitism would not affect willow flycatcher viability. However, the increase in cowbird populations induced by the farming practices, in conjunction with the decline in condition of western riparian habitats, could be contributing to the population decline of willow flycatchers (Rothstein 1994).

Information Needs

Many life history traits of southwestern willow flycatchers require further study, including spacing and site tenacity, fecundity and mortality, mating system, and population structure and regulation. The dispersal and migratory behavior of juveniles is poorly understood, and information is needed on the winter status and distribution for much of the flycatcher's winter range, especially in northern South America (Sedgwich 2000; USFWS 2002a).

Conservation Actions

Maintenance of healthy riparian forest habitats in the San Luis Valley and southwestern Colorado is imperative for the conservation of southwestern willow flycatcher. Implementation of water management policies that encourage sustainable flows and support healthy willow and mature cottonwood riparian forests are needed. Public lands (state wildlife areas, national wildlife refuges, BLM) should be managed to benefit the species. Outreach to landowners and the use of incentive programs to maintain riparian forest and prevent habitat alteration or degradation (e.g., due to overgrazing) are important tasks.

Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Yellow-billed Cuckoo (*Coccyzus americanus*): a technical conservation assessment (2005); Federal listing documents (links in Appendix D).

Threats

2 Incompatible Agriculture

Incompatible grazing by livestock in riparian habitat has resulted in the loss of riparian vegetation, particularly within the arid west (Bock et al. 1993). Grazing in riparian areas can cause changes in the structure and composition of riparian vegetation, which may affect suitability of habitat for western yellow-billed cuckoo breeding and prey population abundance (USFWS 2014b). In the arid mountain regions of the west, water resources and fertile land suitable to support cropland exists mainly along streams, where water for irrigation and rich soils deposited on stream floodplains is found. Large areas of cottonwood–willow floodplain vegetation have been converted to agricultural uses, reducing the extent of habitat available to cuckoos for breeding (USFWS 2002a).

4 Transportation & Service Corridors

Roads and railroads often follow along rivers, causing the loss and degradation of riparian habitat (NAS 2002). Additionally, gravel mining for road construction generally occurs along rivers and in the floodplain, affecting groundwater levels and riparian vegetation (Kondolf 1995).

7 Natural System Modifications

The riparian habitat the western yellow-billed cuckoo depends on has been disturbed by multiple human induced activities, including alteration of hydrology due to dams, water diversions, management of river flow that differs from natural hydrological patterns, channelization, and levees and other forms of bank stabilization that encroach into the floodplain (USFWS 2014b). Impoundments, dams and reservoirs alter the timing, frequency and quantity of flows, which adversely affects riparian vegetation, rendering it unsuitable for cuckoos (Greco 2012). Water diversion and groundwater pumping has resulted in water stress to riparian habitat, ultimately reducing and degrading foraging, nesting, and cover habitat for cuckoos (USFWS 2014b). Channelization, construction of levees, bank stabilization, and flood control structures that encroach into the river and its floodplain cause direct loss of cuckoo habitat and separate the channel from the floodplain. This, in turn, results in reduction of water available to support riparian vegetation in the floodplain, causing the further loss of cuckoo habitat (USFWS 2014b).

Fire within riparian habitats can be particularly damaging because riparian plant communities are not adapted to fire, nor are they fire regenerated. There is evidence that fire has increased in western riparian habitats where streams have been regulated, due in part to the reduction of natural flooding, which has allowed fuels to build up. This situation is further exacerbated by the expansion and dominance of the highly-flammable tamarisk (Busch 1995; Stromberg and Chew 2002). The loss of riparian cottonwood forests due to increased frequency of fire results in the direct loss of cuckoo habitat.

8 Invasives, Problematic Native Species, & Pathogens

Many western waterways have been invaded by tamarisk (*Tamarix ramosissima*). Areas that are dominated by tamarisk are unsuitable for cuckoos (USFWS 2014b). Habitat restoration should employ techniques that are sensitive to temporary impacts to cuckoos inhabiting degraded woodlands.

11 Climate Change & Severe Weather

The primary impacts of climate change on the western yellow-billed cuckoo are expected to be through changes in the availability and distribution of habitat. The predicted effects of climate change in the West include a reduced snowpack and shorter periods of snow cover, snowmelt that occurs earlier in the season, a hydrologic cycle that is more dynamic as extreme rainfall events occur with greater frequency and overall warmer, drier, and more drought-like conditions (USFWS 2014b). The effect of these alterations will be a change in the magnitude and frequency of floods and a greater likelihood of drought. These changes could be either beneficial or detrimental to cuckoos. Where flooding increases water available to riparian floodplains, it may have a regenerative effect on cuckoo habitat, but where channelization has occurred excessive scouring could cause the loss of any remaining habitat (USFWS 2014b). Long droughts could also cause the death of cottonwood riparian forests without subsequent regeneration.

Information Needs

Detailed censuses of declining western populations must continue in order to determine effective population sizes necessary for future conservation programs (Hughes 1999). Various life history traits of the cuckoo require additional research, including spacing and site tenacity, fecundity and mortality, mating system, and population structure and regulation (Hughes 1999). Many characteristics of juvenile biology are unknown, including parental dependence, and dispersal and migratory behavior. Yellow-billed cuckoos are brood parasites that will occasionally lay eggs in other yellow-billed cuckoo nests. Information is needed on the physiological and behavioral controls associated with the production of extra eggs, the frequency of parasitism, and the overall success rates of parasitically laid eggs (Hughes 1999).

Conservation Actions

Western yellow-billed cuckoos are dependent on the maintenance of healthy riparian forests throughout western Colorado and the San Luis Valley. Implementation of water management policies which encourage sustainable flows and support healthy willow and mature cottonwood riparian forests is needed. Public lands (state wildlife areas, national wildlife refuges, BLM) should be managed to benefit the species. Outreach to landowners and the use of incentive programs to maintain riparian forest and prevent habitat alteration or degradation (e.g., due to overgrazing) are important tasks.

TIER 1 FISH

Arkansas Darter (*Etheostoma cragini*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Arkansas Darter (*Etheostoma cragini*) Recovery Plan (2001) (link in Appendix D).

Threats

7 Natural System Modifications

Arkansas darters prefer low-gradient, cool, clear, spring-fed streams with dense vegetation and silty, sandy or sandy gravel substrates (Labbe and Fausch 2000; CPW 2001). Such ideal habitat has been reduced in the lower Arkansas River and its tributaries by anthropogenic activities. Ongoing and extensive water diversions, groundwater mining and impoundments in the Great Plains beginning in the 19th century have altered the hydrologic regime of Arkansas darter habitat, leading to increased drying and habitat intermittency (Falke et al. 2011). Although the Arkansas darter is adapted to the harsh, flashy hydrology of true plains streams, the level of anthropogenic disturbance to this habitat is beyond the limit of what many local species can tolerate in some areas (Fausch and Bestgen 1997; Samson et al. 2004). The mining of groundwater may be particularly detrimental for the species, as a recent study showed that overwinter survival was high in spring-fed pools where groundwater moderated winter temperatures and created patches of cooler water in summer temperatures (Groce et al. 2012). A study of genetic and demographic patterns revealed small effective population sizes, low levels of genetic diversity within populations, and high levels of genetic structure across the 12 remaining populations of Arkansas darter in Colorado (Fitzpatrick et al. 2014). These results suggest that the species may be at risk of negative effects of inbreeding depression, although no such effects have been observed.

8 Invasives, Problematic Native Species, & Pathogens

The non-native northern pike (*Esox lucius*) are predators of Arkansas darter. Results from a study by Labbe and Fausch (2000) indicate that northern pike have greatly reduced the distribution and abundance of the Arkansas darter in a 13 km stretch of upper Big Sandy Creek near Ramah Reservoir. Additionally, non-native largemouth bass (*Micropterus salmoides*), a potential predator, occur in some streams within Arkansas darter range, as a result of stocking into small impoundments.

Other Threats

The degradation of stream banks and shallow wetlands from livestock grazing, and construction activities and water pollution near urban areas, have contributed to the reduction of Arkansas darter habitat in the lower Arkansas River drainage (CPW 2001).

Information Needs

Further elucidation regarding the effect of non-native species on the Arkansas darter is needed. More studies are necessary to understand genetic and adaptive variation across the entire range of the Arkansas darter in Arkansas, Colorado, Kansas, Missouri, and Oklahoma. Fitzpatrick et al. (2014) suggest measuring and comparing fitness-related traits, using genetic data for reconstructing wild pedigrees, and conducting reciprocal transplant experiments as important next steps for long-term management of Arkansas darter populations.

Conservation Actions

Securing water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements) is a key priority, particularly for streams on the plains and in headwater reaches. Efforts should continue to identify additional potential re-introduction sites within the species' native range. Where necessary, agreements should be reached to improve habitat, for example by providing alternative stock-water sources so that over-grazed riparian reaches can be fenced. Culture techniques should continue to be refined, and factors affecting stocking success more formally evaluated.

Bluehead Sucker (*Catostomus discobolus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: State of Colorado conservation and management plan for the Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (in development); Range-wide conservation agreement and strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (2006); Bluehead Sucker (*Catostomus discobolus*): a technical conservation assessment (2005) (links in Appendix D).

Threats

7 Natural System Modifications

The bluehead sucker (*Catostomus discobolus*) was historically common and abundant in the Upper Colorado River and its tributaries within the state of Colorado (Miller and Rees 2000, Ptacek et al. 2005). Presently, they are found in only 45% of this historic range in western Colorado (Bezzarides and Bestgen 2002). The major threats to this species are dams and reservoirs, diversion of water and associated changes in flow, stream channelization, and general

deterioration of riparian corridors (Weitzel 2002a; Ptacek et al. 2005). Dams along the Colorado River and its tributaries have complex direct and indirect effects on the species. Large dams such as Flaming Gorge, Navajo, and the Aspinnall Unit, and associated alterations have directly influenced thermal and hydrological regimes, reducing bluehead sucker populations in both the Lower and Upper Colorado River basins (e.g., Vanicek et al. 1970). Additionally, lowhead dams and constructed wetlands along Muddy Creek, a tributary of the Little Snake River in the Upper Colorado River basin, were shown to restrict downstream movement of bluehead sucker and create novel wetland habitat favoring non-native fish species (Beatty et al. 2009). These dams and constructed wetlands, however, may have positive indirect effects as they create a barrier to the upstream spawning of non-native fish species that prey on, hybridize, and compete with the bluehead sucker for resources. These findings highlight the complex impacts of dams on Colorado's native fish populations (Beatty et al. 2009). Fish passageways have been created for the bluehead sucker and other native fish at dam sites in the Colorado River near Palisade and on the Gunnison River (Landers 2012).

8 Invasives, Problematic Native Species, & Pathogens

Hybridization between the non-native white sucker (*Catostomus commersoni*) and bluehead sucker has been documented, as well as individuals with genetic contributions from the white sucker, bluehead sucker, and native flannelmouth sucker (*Catostomus latipinnus*) (McDonald et al. 2008). The non-native white sucker has facilitated introgression between two native species, and therefore threatens the genetic integrity of the bluehead and flannelmouth suckers. A genetic study of the species revealed three distinct geographic areas that are evolutionarily significant for maintaining the genetic integrity of the bluehead sucker (referred to as evolutionarily significant units): the Bonneville Basin, the Upper Little Colorado River, and the Colorado River (Hopken et al. 2013). All bluehead sucker populations in the state of Colorado belong to the Colorado River unit (Hopken et al. 2013). The bluehead sucker is vulnerable to predation by several non-native fish species including northern pike and brown trout (Nesler 1995; Webber et al. 2012).

Other Threats

The construction of roads through highly erodible soils, improper timber harvest practices, and overgrazing of riparian areas can alter stream channel flows, increase sediment loads, and degrade riparian habitat thereby affecting the quality of occupied bluehead sucker habitat (Ptacek et al. 2005).

Information Needs

Further studies are needed to monitor and detect hybridization of the bluehead sucker with other species, especially non-natives (CPW 2014b). Furthermore, efforts should be made to determine the effectiveness of non-native species removal in bluehead sucker occupied habitat (CPW 2014b). Preliminary work has estimated that the species is fairly long-lived, with age estimates

ranging from 8-18 years at sites in Wyoming (Sweet et al. 2009) and in the White and Gunnison Rivers (CPW unpublished data). More information is needed on population demographics and habitat requirements for bluehead sucker within Colorado, noting any differences among streams (CPW 2014b). The role of tributaries in spawning and life history stages needs further investigation. Ideal habitat for the species should be identified to direct protection efforts throughout the Upper Colorado Basin. Lastly, more research is needed to determine if and where flow stages are too low to support bluehead sucker populations (CPW 2014b).

Conservation Actions

Hybridization with non-native suckers is the most pressing conservation threat. Reaches that presently support bluehead and/or flannelmouth suckers and do not contain non-native suckers should be individually evaluated and all appropriate measures identified to ensure they remain uninvaded. Constructed barriers, in conjunction with mechanical or chemical removal, may be feasible in some streams, to open up additional habitat for re-introduction. Suppression of non-native predators, particularly northern pike and smallmouth bass, must continue throughout the basins where these species have invaded. Colorado's DRAFT Conservation and Management Plan for the 'three species,' which needs to be finalized, specifies additional conservation actions.

Bonytail Chub (*Gila elegans*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Bonytail (*Gila elegans*) Recovery Goals – Amendment and Supplement to the Bonytail Chub Recovery Plan (2002) (link in Appendix D).

Threats

The bonytail chub (*Gila elegans*) is considered functionally extinct in Colorado (Carlson and Muth 1989). This species, endemic to the Colorado River Basin, was once widespread and abundant in the Yampa, Green, Colorado and Gunnison rivers (Jordan 1891). It is now the rarest native fish species in the basin. No verifiable occurrences of wild bonytail chub have been documented in Colorado since 1984, when one individual was caught in the Black Rocks area near Grand Junction, Colorado (Kaeding et al. 1986). A captive broodstock was established from some of the last wild bonytail collected, and stocking of captive-reared individuals is a primary recovery strategy (Nesler et al. 2003). Captive-bred bonytail are tagged with Passive Integrated Transponder (PIT) tags prior to stocking. Stocked fish have been detected in subsequent sampling, sometimes in large numbers, but there is little evidence of long-term survival, and no confirmed reproduction or recruitment. The primary threats to the species are streamflow regulation, habitat modification, predation by non-native fish, hybridization, and pesticides and pollutants (Vanicek and Kramer 1969; USFWS 2002b; Bestgen, Zelasko, and Compton 2006).

3 Energy Production & Mining

A large uranium mill tailings pile from the Atlas Mine near Moab, Utah, poses two significant threats to endangered fish in the Colorado River: 1) toxic discharges of pollutants, particularly ammonia, enter the river through groundwater and could be directly toxic to bonytail chub (*Gilia elegans*); and 2) risk of catastrophic pile failure could bury nursery areas and destroy fish habitat (Fairchild et al. 2002; USFWS 2002b). If functional bonytail chub populations are established in Colorado, individuals may be capable of traveling downstream to areas affected by the mine. However, migration distances for bonytail chub are unknown.

4 Transportation & Service Corridors

The Denver and Rio Grande railroad tracks parallel sections of the Colorado River near Grand Junction, Colorado and Cisco, Utah. No known derailments have occurred in these areas, but potential spills of hazardous materials threaten all endangered fish in this portion of the Colorado River (USFWS 2002b).

7 Natural System Modifications

The construction of dams in the Colorado River Basin has fragmented and inundated riverine habitat; released cold, clear waters; altered ecological processes; affected seasonal availability of habitat; and blocked fish passage (USFWS 2002b). All of these factors have led to the decline of the bonytail chub (Carlson and Muth 1989; Minckley et al. 2003).

8 Invasives, Problematic Native Species, & Pathogens

Non-native fish species now dominate many portions of the Upper Colorado River Basin, comprising 40 of the 54 total species in the basin as a whole (UCREFRP 2004). Many of these non-native species are thought to prey on bonytail chub, including smallmouth bass (*Micropterus dolomieu*), and have been implicated as one of the chief causes for lack of recruitment in native fishes (McAda and Wydoski 1980; Tyus et al. 1987; Minckley 1991; Bestgen, Zelasko, and Compton 2006; Marsh et al. 2013).

9 Pollution

Pollutants and pesticides from agricultural runoff have been suggested as possible threats to the species, but no tissue analysis has been conducted on bonytail chub (Haynes and Muth 1981; Wick et al. 1981).

Information Needs

Few studies on the bonytail chub were completed before populations experienced massive declines. Future studies should focus on understanding the life history and specific habitat requirements of bonytail chub using stocked populations (USFWS 2002b). This information is necessary for improving survival of stocked fish, and for identifying—and if necessary re-creating—the conditions needed for reproduction and recruitment; for example, off-channel

breeding habitat for bonytail chub (Minckley et al. 2003). More studies focusing on the effects of pesticides and pollutants on bonytail chub are also needed.

Conservation Actions

Stocking success must be rigorously evaluated to identify factors contributing to survival. Stocked fish should be tracked as closely as possible to discover presumptive life-history traits. These traits should in turn direct and inform future recovery actions. Suppression of non-native predators, particularly northern pike and smallmouth bass, must continue throughout the basins where these species have invaded. Recovery efforts for this species are coordinated primarily by the Upper Colorado Endangered Fish Recovery Program, in which Colorado is a partner agency.

Brassy Minnow (*Hybognathus hankinsoni*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development).

Threats

The brassy minnow (*Hybognathus hankinsoni*) occurs in the Republican and South Platte river basins (Scheurer and Fausch 2002). The species has experienced a decline in abundance and distribution in Colorado, and was listed as state threatened in 1998 (Scheurer 2001; CPW 2014). Major threats to the species are habitat drying, habitat degradation, and non-native species.

2 Incompatible Agriculture

Grazing by livestock has damaged 80% of the streams and riparian ecosystems in the western United States (USDOI 1994; Belsky et al. 1999). Erosion and siltation from cattle grazing can degrade habitat for native fishes like brassy minnow that prefer clear waters and densely vegetated streambanks with grasses, willows, and cottonwoods (Scheurer and Fausch 2002). Grazing has caused bank erosion in occupied brassy minnow habitat in the Arikaree River (Scheurer et al. 2003).

7 Natural System Modifications

Although this species is adapted to withstand drought conditions that are common in the Great Plains, the additive effects of drought combined with streamflow reduction from diversions, reservoir storage, and irrigation pumping may cause further declines and even the extirpation of the species in Colorado. For example, irrigation pumping from sites in the Arikaree River coincided with the larval hatching season for brassy minnow, causing dewatering of occupied habitat, resulting in the death of most larvae during the dry summer of 2000 (Scheurer and Fausch 2002).

The species uses seasonally flooded habitats for spawning, recruitment and growth (Copes 1975; Goldowitz and Whiles 1999). In the Arikaree River, investigators found that brassy minnow survival and recruitment was strongly influenced by habitat drying as a result of the interactions of groundwater pumping, climate, and stream geomorphology (Falke et al. 2010). The use of temporary habitats makes the species extremely vulnerable to stochastic local extinction (Scheurer and Fausch 2002). Survival of brassy minnow is higher in spawning habitats that are large and dry slowly (Falke et al. 2010). Deep pools complexes, often created by beaver activity, serve as important refugia for the species during drought and winter freezing (Scheurer and Fausch 2002). Any water management activity that alters the processes that create these pools could have negative effects on the brassy minnow.

8 Invasives, Problematic Native Species, & Pathogens

Non-native fish species such as largemouth bass are capable of decimating native fish populations, and may pose a threat to brassy minnow populations in off-channel ponds (Scheurer and Fausch 2002). Smallmouth bass have been shown to have a strong negative effect on brassy minnow (Schlosser 1988).

Information Needs

More surveys, as well as studies evaluating threats and investigating metapopulation dynamics are needed in the South Platte basin in Colorado, as most studies have focused on the Republican River basin.

Conservation Actions

Secure water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements); this is particularly urgent in the Republican basin. Identify potential re-introduction sites within the species' native range, emphasizing opportunities to protect or re-create seasonally connected backwater and slough habitats. Study metapopulation dynamics, to understand importance of barriers and seasonal connectivity in life history, to direct future conservation activities.

Colorado Pikeminnow (*Ptychocheilus lucius*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Colorado Pikeminnow (*Ptychocheilus lucius*) Recovery Goals – Amendment and Supplement to the Colorado Squawfish Recovery Plan (2002); Colorado Squawfish Revised Recovery Plan (1991) (links in Appendix D).

Threats

The Colorado pikeminnow (*Ptychocheilus lucius*) is the largest native fish in the Colorado River basin (Tyus 1991). It was listed as federally Endangered in 1967. Formerly called the Colorado

squawfish, the Colorado pikeminnow is a member of a unique assemblage of fishes that evolved in warm, uninterrupted stretches of the Colorado River and its tributaries (Miller 1959; USFWS 2002c). The species now utilizes approximately 1,090 miles of river habitat in the upper Colorado River Basin above Lake Powell in the Green River, upper Colorado River, and San Juan River subbasins (USFWS 2011b). Wild populations in the lower part of the basin in Arizona, California, Nevada, and New Mexico are extirpated (USFWS 2011b). The wild population in the San Juan subbasin was also functionally extirpated and efforts to recover it are based upon stocking. Colorado pikeminnow are highly migratory, often traveling several hundred river kilometers to spawning sites, and subsequently making the journey in reverse back to a home range (Tyus and McAda 1984; Osmundson et al. 1998). The primary threats to the Colorado pikeminnow are streamflow regulation and associated habitat modification, and non-native fish (USFWS 2002c).

3 Energy Production & Mining

A large uranium mill tailings pile from the Atlas Mine near Moab, Utah, on the north bank of the Colorado River poses two significant threats to Colorado pikeminnow: toxic discharges of pollutants and risk of catastrophic pile failure (USFWS 2011b).

7 Natural System Modifications

Dam construction has resulted in the loss and degradation of habitat for the Colorado pikeminnow across its native range (Minckley and Deacon 1968; Clarkson and Childs 2000). Extensive dam building in the 1930s through the 1960s has been cited as the primary cause for the extirpation of Colorado pikeminnow in the lower Colorado River basin (Mueller and Marsh 2002; Osmundson 2011). Although the species still persists in the upper Colorado River basin, dams have blocked upstream passage, converted free-flowing riverine segments into lentic reservoir habitat, and cooled downstream reaches with hypolimnetic releases (Osmundson 2011). Altered flow regimes from dams and diversions can affect food web dynamics and interactions between Colorado pikeminnow and non-native fish species (Osmundson et al. 2002; Bestgen, Zelasko, and Compton 2006, Bestgen, Beyers, Rice, and Hains 2006). Flow recommendations that consider these dynamics have been developed for Colorado pikeminnow (Modde and Smith 1995; Osmundson et al. 1995; Holden 1999; McAda 2000; Muth et al. 2000). Other water management activities such as irrigation and groundwater pumping can result in high levels of selenium that may affect the survival and reproductive success of Colorado pikeminnow (Simpson and Lusk 1999; Osmundson et al. 2000; Osmundson et al. 2008). Entrainment of larval and/or adult pikeminnow into irrigation canals remains a significant cause of mortality (data in prep).

8 Invasives, Problematic Native Species, & Pathogens

Colorado pikeminnow occur sympatrically with approximately 20 non-native fishes that are suspected to compete with and prey upon Colorado pikeminnow at various life stages, including

red shiners (*Cyprinella lutrensis*), fathead minnow (*Pimephales promelas*), channel catfish (*Ictalurus punctatus*), northern pike (*Esox lucius*), smallmouth bass (*Microperus dolomieu*), walleye (*Sander vitreus*), and green sunfish (*Lepomis cyanellus*) (USFWS 2002c, 2011b). Smallmouth bass, northern pike, walleye and channel catfish have been identified as the principal non-native threats to adult and sub-adult Colorado pikeminnow, with burbot (*Lota lota*) an emerging new predator (Johnson et al. 2008). These non-native fishes occupy the same habitat types as Colorado pikeminnow and likely compete for food resources (USFWS 2002c; Franssen and Durst 2014).

Information Needs

Fish passageways have been created at several dams in the Upper Colorado River basin. Long-term monitoring should be in place to assess the effectiveness of the passageways for Colorado pikeminnow, as well as their use by non-native fish species. Also, more information is needed on the impacts of climate change to the Colorado River basin and its native fish species (USFWS 2011b). Lastly, more studies are needed to assess the impact of mercury on Colorado pikeminnow, as it may be causing reproductive impairment (USFWS 2011b).

Conservation Actions

Continue non-native predator suppression throughout the basins where these species have invaded, and continue to improve its effectiveness. Continue to conduct habitat improvement in appropriate areas, to benefit native fish and disadvantage non-natives. In collaboration with the Upper Colorado Endangered Fish Recovery Program, assess entrainment at unscreened diversions and screens that do not operate continuously. Assess utilization of fish passage structures. Evaluate potential and pursue opportunities to develop experimental nonessential populations, disconnected from critical habitat, as fisheries. Recovery efforts for this species are coordinated primarily by the Upper Colorado Endangered Fish Recovery Program, in which Colorado is a partner agency.

Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Range-wide Status of Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*): 2010 (2013); Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*): a technical conservation assessment (2008); Conservation Agreement for Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*) in the States of Colorado, Utah, and Wyoming (2006) (links in Appendix D).

Threats

The Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) presently occurs in Colorado, Utah, and Wyoming (Hirsch et al. 2013). It formerly also inhabited portions of northern Arizona and New Mexico, but has been extirpated from those states (Hirsch et al. 2013). It is one of the three extant subspecies of trout native to Colorado (Behnke 1992; CPW 2014), and the only subspecies indigenous to Colorado's West Slope. Colorado River cutthroat trout (CRCT hereafter) are found in the following river basins of Colorado: Dolores, Gunnison, Upper Green, Upper Colorado, Yampa, White, and San Juan (Hirsch et al. 2013). Recent genetic and meristic studies have identified two extant cutthroat lineages within this range, provisionally designated the Blue Lineage, native to the Yampa, Green and White River Basins, and the Green Lineage, native to the Upper Colorado, Gunnison and Dolores basins (Metcalf et al. 2012; Bestgen, Rogers, and Granger 2013; USFWS 2014d). A third lineage native to the San Juan basin is evidently extinct, though blue and green lineage populations have been established in this basin by stocking. In keeping with currently-recognized inland cutthroat taxonomy, this account considers all cutthroats indigenous to the West Slope as CRCT (see the greenback cutthroat trout narrative for further detail). The subspecies occupies only 7% of its historic range in Colorado (Hirsch et al. 2013), and is considered a species of special concern (CPW 2014).

2 Incompatible Agriculture

Intense concentrations of livestock can degrade habitat for CRCT by damaging stream banks, increasing sediment concentrations, and removing streambank and aquatic vegetation (Belsky et al. 1999; Agouridis et al. 2005).

3 Energy Production & Mining

Mining in Colorado has altered stream channels and flushed heavy metals into water bodies. These impacts have resulted in the loss of native fish habitat and in some cases extensive fish kills (Alves 1997a). Although mining was present within the influence zone of only 12 CRCT sites rangewide (Hirsch et al. 2013), drainages in CRCT habitat could be affected by heavy metal pollution.

4 Transportation & Service Corridors

The most common land uses occurring in the area of influence around CRCT conservation populations are recreation (non-angling and angling), livestock grazing, and timber harvest (Hirsch et al. 2013). A network of roads exists to support these land use activities, and these roads can create higher sediment loads in streams (Eaglin and Hubert 1993; Trombulak and Frissell 2000). Roads often require culverts that can create barriers to fish passage (Young 2008).

7 Natural System Modifications

Habitat degradation from water development activities has contributed to the extirpation or reduction of CRCT populations across its native range (Young 2008). Interactions of stochastic

disturbances, such as channel drying and freezing, together with habitat fragmentation threaten CRCT populations, especially those that occupy stream reaches that are <7km long (Roberts et al. 2013). As of 2010, 27 out of 361 CRCT conservation populations have received in-stream flow enhancements (Hirsch et al. 2013).

8 Invasives, Problematic Native Species, & Pathogens

Nonnative salmonids have affected populations of CRCT through hybridization, food and space competition, and predation. For example, nonnative rainbow trout (*Oncorhynchus mykiss*) have hybridized with CRCT, thus reducing the genetic integrity of the subspecies (Allendorf and Leary 1988; Forbes and Allendorf 1991; CRCT Conservation Team 2006; Hirsch et al. 2013). Managers recognize “conservation populations” as those that exist in a genetically unaltered condition (>99% purity) and/or have unique ecological, genetic, and behavioral attributes of significance that may be genetically introgressed (Utah Division of Wildlife Resources 2000; Hirsch et al. 2013). Brown trout (*Salmo trutta*) are predatory on CRCT (Hirsch et al. 2013). Rainbow, brown, and brook trout (*Salvelinus fontinalis*) all compete with CRCT for food and space (Hirsch et al. 2013). As of 2010, 54 conservation populations have experienced physical removal of competing/hybridizing species, and 51 have experienced chemical removal of competing/hybridizing species (Hirsch et al. 2013).

Natural or constructed barriers exist to limit genetic mixing of nonnative trout species and CRCT. However, these barriers also pose a threat to CRCT as they tend to restrict individuals to short, headwater stream segments (Young 2008). This restriction renders populations more vulnerable to extirpation from stochastic events, and could result in the long term loss of genetic variability (Young 2008; Roberts et al. 2013).

Whirling disease (*Myxobolus cerebralis*, WD) is a threat to CRCT. Habitat currently inhabited by CRCT is generally not optimal for tubifex worms (essential to the life history of the WD parasite), due to higher gradient, cold water and lack of organic matter. However, research has shown that high elevational habitats are still susceptible to infection. Regulatory mechanisms have been put in place to prevent stocking of WD-positive fish into any salmonid habitats.

Information Needs

Restoration, conservation, and management activities have been implemented for CRCT conservation populations. More information is needed on the effectiveness of these actions (Hirsch et al. 2013).

Conservation Actions

Provide additional security for existing populations where needed (e.g., through easements, setbacks, landowner agreements, barriers). Identify opportunities to extend length of available habitat for existing populations and, especially, to restore presumed metapopulations by

connecting populations that are currently isolated. Identify additional potential re-introduction sites within the species' historic range, and aggressively pursue re-introduction opportunities. Emphasis should especially be given to protecting and establishing additional GL populations, as well as those with potential unique life history adaptations (e.g., thermal tolerance).

Common Shiner (*Luxilus cornutus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development).

Threats

The common shiner (*Luxilus cornutus*) occurs in the South Platte River Basin (CPW 2014). It is rare in the mainstem South Platte River and has been documented in only four of its tributaries (Goettl 1981; Propst 1982; Nesler et al. 1997). It is one of several "glacial relict" fish species restricted to the transition zone along the Front Range, and subject to a number of threats associated with urban development (Fausch and Bestgen 1997, and see "transition zone" description in Habitat section of this Plan). The common shiner was listed as state threatened in 1998 (CPW 2014).

2 Incompatible Agriculture

Excessive grazing in riparian zones can lead to erosion and siltation that compromises the cool, clear waters and clean gravels that are required for common shiner (Trial et al. 1983; Rahel and Hubert 1991; Belsky et al. 1999; CPW 2014). The species is not able to spawn in silt-bottomed streams (Miller 1964).

7 Natural System Modifications

Although the streams historically and presently inhabited by common shiner continue to have perennial flows, most are moderately to heavily fragmented by diversion structures that are barriers to fish movement, and likely reduce connectivity to spawning and rearing habitat in at least some cases. Flow regime alteration may produce a mismatch between spawn timing and spawning habitat availability, compounded by channel alteration resulting in disconnected floodplain. Altered thermal regimes may also arise from hydrologic alteration and potentially impact life history processes.

Siltation has been identified as the primary factor in the extirpation of common shiner in several Front Range streams where they formerly occurred (Propst 1982; Nesler et al. 1997). As a result of vast urban development and the resulting loss of proper stream function, siltation is a widespread issue across nearly all common shiner habitats in Colorado. Studies of common

shiner in Vermont indicated that the species needs both riffle and pools, and in Wyoming it was associated with moderate currents (Rahel and Hubert 1991; Clark et al. 2008). Any water management activity that alters the processes that maintain these habitats could result in the further decline of common shiner in Colorado.

8 Invasives, Problematic Native Species, & Pathogens

Non-native fishes including predatory species have become increasingly abundant in Front Range streams such as Boulder Creek, Saint Vrain Creek, and the Cache La Poudre River, where common shiners formerly or presently occur. Native fish (though not specifically common shiner) have been found to comprise a large proportion of the diet of non-native largemouth bass in the St. Vrain, where an imperiled population of common shiner occurs (CPW unpublished data). Brown trout also co-occur with common shiner in St. Vrain and other Front Range streams and have increased in numbers coincident with apparent declines in common shiner abundance (CPW unpublished data). Aspects of the common shiner's life history could make it particularly vulnerable to predation.

Information Needs

More information is needed on the life history, habitat requirements, and ecology of common shiner. More surveys are needed to determine its abundance and current distribution in Colorado. Lastly, more studies are needed to identify primary threats to the species.

Conservation Actions

Securing water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements) is a key priority. Continue efforts to identify additional potential re-introduction sites within the species' presumptive native range. Identify opportunities for habitat improvement to create or restore suitable habitat. Evaluate feasibility of measures to suppress non-native predation on the St. Vrain population, and take any suitable actions. Re-establish a captive broodstock at the Mumma Native Aquatic Species Restoration Facility (NASRF) and/or in secure, isolated ponds. If appropriate, augment the St. Vrain population through stocking, and create additional populations through stocking when suitable habitat becomes available.

Flannelmouth Sucker (*Catostomus latipinnis*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: State of Colorado conservation and management plan for the Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (in development); Range-wide conservation agreement and strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth

Sucker (*Catostomus latipinnis*) (2006); Flannelmouth Sucker (*Catostomus latipinnis*): a technical conservation assessment (2005) (links in Appendix D).

Threats

The flannelmouth sucker (*Catostomus latipinnis*) occurs in large streams and rivers in the Western United States. In Colorado, it is found on the western slope in the Upper Colorado River Basin (Bezzarides and Bestgen 2002). The species has declined throughout the Basin, and now occupies half of its historic range (Bezzarides and Bestgen 2002). It has no listing status by the state of Colorado or the U.S. Fish and Wildlife Service. Habitat degradation and interactions with non-native species have been identified as the primary threats to flannelmouth sucker (Tyus and Saunders 2000; Rees, Ptacek, Carr, and Miller 2005; CPW 2014b).

2 Incompatible Agriculture

Intense concentrations of livestock can degrade habitat for flannelmouth sucker by damaging stream banks, increasing sediment concentrations, and removing streambank and aquatic vegetation (Belsky et al. 1999; Agouridis et al. 2005). Increased sediment loads could have a negative impact on flannelmouth sucker populations (Rees, Ptacek, Carr, and Miller 2005), but the exact mechanisms and thresholds for the species are unknown.

4 Transportation & Service Corridors

Road construction for timber harvesting, agriculture, recreation, and housing development can fragment native fish habitat and increase sediment loads in streams. Higher sediment loads can result in changes to stream channel geometry, thereby affecting the quality of habitat for flannelmouth sucker (Rees, Ptacek, Carr, and Miller 2005). The species has been shown to be highly associated with deep runs (Anderson and Stewart 2003, 2007), and changes in channel geometry could result in less availability of these runs.

7 Natural System Modifications

Large dams such as Flaming Gorge, Navajo, and the Aspinall Unit, and the associated alterations have directly influenced thermal and hydrological regimes, reducing flannelmouth sucker populations in both the Lower and Upper Colorado River basins (e.g., Vanicek et al. 1970). Habitat loss has occurred through the de-watering of streams and the construction of dams that block the movement of flannelmouth sucker (Rees, Ptacek, Carr, and Miller 2005). Dams, impoundments and diversions can cause changes in channel geometry, water chemistry, water temperature and flow regimes. These changes can affect the quality of habitat occupied by flannelmouth suckers (Rees, Ptacek, Carr, and Miller 2005). For example, hypolimnetic dam releases have been shown to slow the growth of flannelmouth suckers, delay transition to the juvenile stage, and decrease swimming ability (Clarkson and Childs 2000; Ward et al. 2002). Changes in flow regimes and water temperature created by Flaming Gorge Dam displaced flannelmouth suckers to warmer locations during summer and reduced spawning success

(Vanicek et al. 1970). Impoundments can also have negative impacts on flannelmouth sucker populations (McAda 1977; Chart and Bergersen 1992; Bezzerides and Bestgen 2002). Although water development activities are generally viewed as detrimental to the native fish species that evolved in the lower Colorado River, there is evidence that the altered conditions can support natural flannelmouth sucker reproduction in areas downstream of the Grand Canyon (Mueller and Wydoski 2004).

Lowhead dams and constructed wetlands along Muddy Creek, a tributary of the Little Snake River in the Upper Colorado River basin, were shown to restrict downstream movement of flannelmouth sucker and create novel wetland habitat favoring non-native fish species (Beatty et al. 2009). These dams and constructed wetlands, however, may have positive indirect effects as they create a barrier to the upstream spawning of non-native fish species that prey on, hybridize, and compete with flannelmouth sucker for resources. These findings highlight the complex impacts of dams on Colorado's native fish populations (Beatty et al. 2009). Fish passageways have been created for the flannelmouth sucker and other native fish at dam sites in the Colorado River near Palisade and on the Gunnison River (Landers 2012).

8 Invasives, Problematic Native Species, & Pathogens

Nonnative fish species hybridize with and prey upon flannelmouth sucker. The nonnative northern pike is a known predator of flannelmouth sucker (Nesler 1995). Other nonnative fish species that are common in the Colorado River and its tributaries, such as brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), red shiner (*Notropis lutrensis*), and smallmouth bass (*Micropterus dolomieu*), likely also eat flannelmouth sucker, though direct evidence is lacking for some of these species (Rees, Ptacek, Carr, and Miller 2005). Hybrids between nonnative white sucker (*Catostomus commersoni*) and flannelmouth sucker have been documented in the Colorado, Gunnison, and Yampa rivers (Douglas and Douglas 2003; Shiozawa et al. 2003; Anderson and Stewart 2007). Hybridization between the non-native white sucker and the native bluehead sucker has also been documented, as well as individuals with genetic contributions from the white sucker, bluehead sucker, and native flannelmouth sucker (*Catostomus latipinnus*) (McDonald et al. 2008). The non-native white sucker has facilitated introgression between two native species, and therefore threatens the genetic integrity of the bluehead and flannelmouth suckers. White suckers have become pervasive throughout the Colorado River Basin, hybridizing readily with flannelmouth suckers, thus creating a serious extinction risk to flannelmouth suckers (McDonald et al. 2008).

Information Needs

Information about flannelmouth sucker has been collected as a by-product of studies for other Colorado River fish that are federally listed (Rees, Ptacek, Carr, and Miller 2005), but more studies need to focus on obtaining information on the life history, ecology, movement patterns,

influence of non-native fish species, and the effects of anthropogenic habitat modification (Rees, Ptacek, Carr, and Miller 2005).

Conservation Actions

Hybridization with non-native suckers is the most pressing conservation threat. Reaches that presently support flannelmouth and/or bluehead suckers and do not contain non-native suckers should be individually evaluated and all appropriate measures identified to ensure they remain uninvaded. Constructed barriers, in conjunction with mechanical or chemical removal, may be feasible in some streams, to open up additional habitat for re-introduction. Suppression of non-native predators, particularly northern pike and smallmouth bass, must continue throughout the basins where these species have invaded. Colorado's DRAFT Conservation and Management Plan for the 'three species,' which needs to be finalized, specifies additional conservation actions.

Flathead Chub (*Platygobio gracilis*)

Threats

Flathead chub (*Platygobio gracilis*) occupy the mainstems of turbid rivers from the Northwest Territories of Canada south to Texas (Kucas 1980). In Colorado, the species is found in the Arkansas and Rio Grande river basins (Alves 1997b; Nesler et al. 1999). Its range within the state has been reduced (Woodling 1985; CPW unpublished data), and it is now listed as a species of special concern (CPW 2014).

2 Incompatible Agriculture

Overgrazing by livestock can degrade flathead chub habitat by increasing stream width, decreasing channel depth, and increasing stream intermittency (Platts 1991; Rahel and Thel 2004a). Livestock waste in streams occupied by flathead chub can decrease water quality by lowering oxygen concentrations and increasing ammonia (Scarnecchia 2002).

3 Energy Production & Mining

Heavy metal contamination from mining activities has been proposed as a contributing factor to the loss of flathead chub in the Arkansas River between the towns of Salida and Florence, Colorado (Woodling 1985; Rahel and Thel 2004a). Although water quality has improved in this stretch of the Arkansas River (Rahel and Thel 2004a), historic mines can still pose a threat to flathead chub. Stochastic events such as extreme rainstorms and mudslides can flush heavy metals from these mines into water bodies and cause extensive fish kills (Alves 1997a).

A significant amount of coalbed methane production occurs in the Raton Basin: an area that contains the Purgatorie River as well as smaller streams that are tributaries to the Arkansas River. Flathead chub have been documented as one of the most common fish species in the Purgatoire

River (Bramblett and Fausch 1991; Nesler et al. 1999; CPW unpublished data). Wastewater produced by coalbed methane production in the Purgatoire River drainage could alter streamflow conditions, making them more favorable for nonnative fish species. Discharged wastewater can convert intermittent streams on the plains into perennial flows (Freilich 2004), which in turn could allow the establishment of nonnative piscivorous fish (Rahel and Thel 2004a). This produced wastewater could also result in higher concentrations of saline and heavy metals, which could be toxic to flathead chub (Rahel and Thel 2004a).

7 Natural System Modifications

Water development activities have led to the loss and degradation of habitat for flathead chub. Irrigation and groundwater pumping have caused channel dewatering in the Great Plains, resulting in loss of suitable habitat for the chub (Rahel and Thel 2004a). The species has been extirpated in the Arkansas River in western Kansas due to groundwater pumping from the Ogallala Aquifer (Cross and Moss 1987).

In Colorado, the apparent decline or disappearance of flathead chub from some stream reaches coincides strongly with fragmentation by diversion structures, dams and other barriers (CPW unpublished data). Impoundments and dams can negatively affect flathead chub populations by blocking fish movement, changing turbidity levels, creating reservoir habitat that can favor nonnative piscivores, and altering flow regimes (Bonner and Wilde 2002; Quist et al. 2004, Walters et al. 2014). Dams and impoundments also fragment habitat by dissecting long, continuous stretches of free-flowing streams that the species appears to require (Durham and Wilde 2008). Perkin and Gido (2011) estimated a minimum fragment length required for persistence as approximately 180 river kilometers, which is consistent with observed distribution patterns in Colorado. The abundance of flathead chub has been shown to be positively correlated with the percentage of fine substrate in the Missouri River drainage (Quist et al. 2004). Dams and impoundments typically lower the percentage of fine substrate downstream, creating less favorable habitat for flathead chub, a species associated with turbid plains river systems.

8 Invasives, Problematic Native Species, & Pathogens

Non-native piscivores can negatively affect flathead chub through competition and predation. The influence of these piscivores likely interacts with the effects of impoundment such as stabilized flows and reduced turbidity (Quist et al. 2004). These changes can give sight-feeding non-native predators an advantage over species like flathead chub that evolved in turbid, dynamic river systems (Rahel and Thel 2004a). The combined effects of non-native piscivores and large impoundments and reservoirs are thought to have had a significant effect on flathead chub in portions of its range (Cross and Moss 1987; Pflieger and Grace 1987; Bonner and Wilde 2000).

Information Needs

Research is needed to elucidate the mechanisms responsible for population trends in the Arkansas and Rio Grande river basins in Colorado (Rahel and Thel 2004). The life history of this species is poorly known, although research projects are underway within Colorado (Colorado State University and CPW) that will significantly increase our understanding, particularly of reproductive ecology and fish movement. Lastly, more research is necessary to understand the role of competitors and predators in limiting population size of flathead chub (Rahel and Thel 2004a).

Conservation Actions

Continue ongoing studies of life history requirements and population dynamics in Fountain Creek. Evaluate restoration potential in reaches from which flathead chub have declined or disappeared, given results of these studies. Rigorously evaluate impacts of the newly-constructed fish passage structure at Owens-Hall diversion, and of Southern Delivery System infrastructure and operations, once in effect.

Greenback Cutthroat Trout (*Oncorhynchus clarkii stomias*)

For available information on threats and conservation actions needed for this species, refer to the following resources: Greenback Cutthroat Trout (*Oncorhynchus clarkii stomias*): a technical conservation assessment (2009); Greenback Cutthroat Trout Recovery Plan (1998) (links in Appendix D). Planning documents currently in preparation (multi-agency MOU; Recovery Outline) will provide the framework for future conservation actions once they are completed.

Introduction

The greenback cutthroat trout (*Oncorhynchus clarkii stomias*) has been the subject of intense research and extensive conservation efforts in Colorado for over forty years. It was federally listed as endangered in 1973, then downlisted to threatened in 1978. Recently, genetic and meristic studies have supported major changes to traditionally held views on the taxonomy and distribution of cutthroat trout subspecies occurring within Colorado (USFWS 2014d). Until recently, the greenback cutthroat trout was considered to be the subspecies native to drainages east of the Continental Divide (Behnke 1992; USFWS 1998a; Young 2009), was thought to be represented on the landscape by a number of populations, and was being considered for delisting. Recent genetic and meristic studies revealed that Bear Creek, in the Arkansas River Basin west of Colorado Springs, contained the only known remaining population of greenback cutthroat trout in the world (Metcalf et al. 2012; Bestgen, Rogers, and Granger 2013; USFWS 2014d). The Bear Creek population likely represents the cutthroat trout lineage that was native to the South Platte River (Metcalf et al. 2012), ironically now occurring in Bear Creek as a result of stocking efforts from South Platte River sources (Kennedy 2010; Rogers 2012).

Other than the Bear Creek population, East Slope cutthroat populations that were formerly assumed to be greenback cutthroat trout now appear to represent one of two lineages, temporarily known as the Blue Lineage (hereafter BL) and the Green Lineage (hereafter GL) (Metcalf et al. 2007, 2012; Bestgen, Rogers, and Granger 2013; USFWS 2014d). BL populations almost certainly arise from early stocking efforts driven by wild spawn operations at Trappers Lake, in the headwaters of the White River Basin, from which at least 80 million eggs were taken in the first half of the 20th century. A full understanding of the GL populations' origins remains problematic; they may be native to the Western Slope and present on the East Slope due to stocking efforts (Metcalf et al. 2007, 2012); however the amount of genetic diversity among GL populations, as well as the distribution of unique genotypes, suggests that some GL populations may in fact be East Slope natives (USFWS 2014d). Ongoing research efforts are underway to help clarify the taxonomy of the GL.

At this writing inland cutthroat taxonomy has not been formally revised to reflect the recent findings. In terms of federal listing status, until FWS completes the ESA status review all populations that had previously been considered as "greenback cutthroat trout" continue to receive protection under the ESA. This includes populations of green lineage in Colorado on both sides of the Continental Divide.

Regardless of eventual taxonomic and regulatory status decisions, the lineage represented by Bear Creek will certainly remain a top conservation priority, as will the genetically unique GL populations. East Slope BL populations are probably a lower conservation priority because they are all replicates of the Trappers Lake source population, and the lineage is relatively well-represented on the West Slope. This summary will focus on the primary threats to the GL on the East Slope and the Bear CCreek GCT (threats to West Slope GL and BL are described in the Colorado River Cutthroat Trout narrative). Historically, the main threats to GL were mining, agriculture and water development activities (Young 2009). Non-native species introductions and invasions are likely the cause of more recent declines (Young 2009). Primary ongoing threats to the Bear Creek GCT are recreation activities. A short account of these threats is provided below.

Threats to Bear Creek Greenback Cutthroat Trout

6 Human Intrusions & Disturbance

Bear Creek is located on the east side of Pike's Peak west of Colorado Springs. A network of Pike National Forest trails winds through occupied BCGCT habitat. Sections of the trail are highly eroded from heavy use, and are resulting in the loss of vegetation and increased sediment loading in Bear Creek (Reed and Billmeyer 2010). Efforts are underway to control sediment influx from trail erosion (Reed and Billmeyer 2010).

Threats to the Green Lineage

2 Incompatible Agriculture

Intense concentrations of livestock in riparian zones often lead to bank damage, higher sediment loading in streams, and the removal of streambank vegetation (Belsky et al. 1999; Agouridis et al. 2005). These changes can contribute to trout population reductions (Young 2009).

3 Energy Production & Mining

Mining in GL habitat has caused alterations in stream channel geometry, contributed to higher sediment loads, and released toxic substances such as heavy metals (Young 2009). Regulations on new mines are much more stringent today, but massive rainstorms, mudslides, or other stochastic events could lead to the release of heavy metals from historic mines and result in catastrophic fish kills such as those documented in Kerber Creek (Alves 1997a).

7 Natural System Modifications

Most current populations are established within headwater reaches on public lands and are not typically subject to water management issues.

8 Invasives, Problematic Native Species, & Pathogens

Competition and predation by introduced non-native salmonids (brown trout *Salmo trutta*, brook trout *Salvelinus fontinalis* and rainbow trout *Oncorhynchus mykiss*) are serious threats. Additionally, cutthroats hybridize readily with rainbow trout creating an introgressed hybrid swarm. Most cutthroat populations that persist occur upstream of natural or artificial barriers that prevent invasion by non-native salmonids.

Whirling disease (WD) is a threat to greenback cutthroat trout. Habitat currently inhabited by greenbacks is not considered optimal habitat for tubifex worms (essential to the life history of the whirling disease parasite), due to higher gradient, cold water and lack of organic matter. However, research has shown that high elevational habitats are still susceptible to infection. Regulatory mechanisms have been put in place to prevent stocking of WD-positive fish into any salmonid habitats.

Information Needs

More work is needed to resolve the taxonomy of the Bear Creek and Green lineages. East and West Slope Green Lineage fish have distinct morphological and genetic differences that warrant additional investigation (Bestgen, Rogers, and Granger 2013). Additional meristic studies of museum specimens, especially from the South Platte River basin, are also needed (Bestgen, Rogers, and Granger 2013).

Conservation Actions

Aggressively pursue opportunities to establish additional BCGCT populations within the species' presumptive native range. Rigorously evaluate translocation success to determine extent of future stocking (e.g., are the effects of recent genetic bottlenecks pronounced?). Secure additional protection as needed for the extant population in Bear Creek, and for GL populations on the East Slope.

Humpback Chub (*Gila cypha*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Humpback Chub (*Gila cypha*) Recovery Goals – Amendment and Supplement to the Humpback Chub Recovery Plan (2002); Humpback Chub 2nd Revised Recovery Plan (1990) (links in Appendix D).

Threats

The humpback chub is endemic to the Colorado River. It is a member of a suite of federally endangered “big river” fish species including bonytail chub (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*). Once common in the Colorado River, humpback chub are now restricted to approximately 7,300 to 13,800 individuals spread among six extant populations (USFWS 2002d). Only two of those populations exist in Colorado: the Yampa Canyon population on the Yampa River and the Black Rocks population on the Colorado River. The Yampa population has declined dramatically and is extremely imperiled. The primary threats to humpback chub identified in the Federal Recovery Plan are streamflow regulation, habitat modification, predation by non-native fish species, parasitism, hybridization with other native *Gila*, and pesticides and pollutants (USFWS 2002d).

4 Transportation & Service Corridors

The Denver and Rio Grande Western railroad tracks parallel the Colorado River at Black Rocks and Westwater Canyon. Potential hazardous waste spills resulting from a train derailment threaten humpback chub populations in these areas. A network of pipelines containing petroleum products cross or closely follow the Yampa River upstream of Yampa Canyon, none of which contain emergency shut-off valves (USFWS 2002d). Leaking or bursting pipes could result in deleterious effects to the fish community in the Yampa River.

7 Natural System Modifications

The construction of dams along the mainstem of the Colorado River and its tributaries has fragmented and inundated riverine habitat, released cold, clear waters; altered ecological processes; affected seasonal availability of habitat; decreased turbidity that serves as cover from predators and creates sandy backwater habitat for young humpback chub; and blocked fish

passage (Minckley and Deacon 1968; Marsh and Douglas 1997; Valdez and Ryel 1997; USFWS 2002d). Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by humpback chub in Colorado including Black Rocks (McAda 2000) and Yampa Canyon (Modde and Smith 1995; USDOJ 1995; Modde et al. 1999; USFWS 2002d). The Green River Dam in Utah is slated for rehabilitation, and the final plans for renovation include a fish passageway to allow for the upstream and downstream movement of native fishes, including humpback chub (USDOA 2014).

8 Invasives, Problematic Native Species & Genes, & Pathogens

Predation by non-native northern pike (*Esox lucius*) and smallmouth bass (*Micropterus dolomieu*) has likely impacted the Yampa Canyon population. These non-native species remain uncommon in the Black Rocks section of the Colorado, although they may have increased recently.

The non-native Asian tapeworm (*Bothriocephalus acheilognathi*) has been implicated in the decline in the condition of humpback chub below Glen Canyon Dam (Meretsky et al. 2000). In 2005, an Asian tapeworm was documented for the first time in a roundtail chub (*Gila robusta*) in the Yampa River (Ward 2005). The tapeworm could pose a serious threat to the humpback chub populations in Colorado as they are difficult to eradicate, have a rapid life cycle of only 15 days, and are non-host specific (Hoffman 1976; Granath and Esch 1983).

Several members of the genus *Gila* reside in the Colorado River including humpback chub (*G. cypha*), roundtail chub (*G. robusta*), and bonytail chub (*G. elegans*). While members of the group historically were likely allopatric, dams and diversions have eliminated or compromised the realized niches of these species, and they now occur sympatrically (Douglas et al. 1998). Morphological characters can be used to separate out each taxon, but hybrids often possess intermediate characters. Hybrid intermediacy has led to inaccurate field identification. In Black Rocks and Westwater Canyon, researchers have documented higher proportions of roundtail chub during low flow years (Kaeding et al. 1990; Chart and Lentsch 2000). These low flow years result in increased sympatry between both chub species, and potentially increase the chances for hybridization (USFWS 2002d). Thus, it is necessary to mimic natural hydrological flow regimes to maintain natural proportions of *Gila* species and intergrades (USFWS 2002d).

9 Pollution

Pollutants and pesticides from agricultural runoff have been suggested as possible threats to the species, but no tissue analysis has been conducted on humpback chub (Haynes and Muth 1981; Wick et al. 1981).

Information Needs

Because of the difficulty of sampling in canyon-bound, big river reaches preferred by this species, accurate population estimates are particularly difficult to obtain. Life history studies in Arizona at the confluence of the Little Colorado River and the Colorado River have revealed that larger adults spawn more frequently than smaller adults, that there are residents in spawning grounds, and that juveniles move out of the Little Colorado River in large numbers during monsoon season (July-September) (Yackulic et al. 2014). Comparably detailed studies that focus on movement, growth, and survival of humpback chub are needed in occupied habitat in the state of Colorado at Black Rocks near Grand Junction and Yampa Canyon. More information is needed to determine the extent, if any, of Asian tapeworm infestations and any associated declines in the condition of humpback chub in Yampa Canyon and Black Rocks. Tissue analysis of humpback chub is also needed to determine levels of bioaccumulation of pesticides and pollutants (USFWS 2002d).

Conservation Actions

Continue to suppress non-native predators, particularly northern pike and smallmouth bass, throughout the basins where these species have invaded. Recovery efforts for this species are coordinated primarily by the Upper Colorado Endangered Fish Recovery Program, in which Colorado is a partner agency.

Mountain Sucker (*Catostomus platyrhynchus*)

Threats

The mountain sucker (*Catostomus platyrhynchus*) is distributed throughout western North America. In Colorado, it occurs in the northwestern part of the state in the Green River drainage, as well as the headwaters of the Colorado, Yampa, and White rivers (Snyder 1981; Belica and Nibbelink 2006). Population trends are largely undocumented for Colorado, but declines have been documented in California (Erman 1986), Wyoming (Patton et al. 1998), and South Dakota (Schultz and Bertrand 2012). It is listed as a species of special concern in Colorado (CPW 2014).

3 Energy Production & Mining

This species occurs in northwestern Colorado, an area that has undergone significant energy development in the last decade. More roads and culverts have been built in the area, and this could result in the fragmentation of mountain sucker habitat. Spills from oil and gas related activities could result in the contamination of occupied mountain sucker habitat.

7 Natural System Modifications

Dams and impoundments can fragment habitat and create barriers to movement, eliminate habitat, and alter fish species assemblages (Decker and Erman 1992; Moyle 2002; Belica and Nibbelink 2006). All of these changes can threaten the long-term survival of mountain sucker. Populations that occur downstream from dams may experience changes in flow regimes and water temperatures. These could have deleterious effects on mountain sucker (Belica and Nibbelink 2006).

Backwater pools and off-channel habitats provide refugia for mountain suckers in the presence of non-native brown trout (Olsen and Belk 2005). Water management activities that degrade or eliminate off-channel habitats could exacerbate the negative effects of predatory, non-native fish species (Scott and Helfman 2001; Olsen and Belk 2005).

8 Invasives, Problematic Native Species, & Pathogens

Predation from non-native salmonids is considered a potentially limiting factor for mountain sucker (Isaak et al. 2003). For example, mountain sucker has been found to be negatively associated with the predatory, non-native brown trout (*Salmo trutta*) (Decker and Erman 1992; Giddings et al. 2006; Dauwalter and Rahel 2008). Interactions with other non-native fish species are largely unknown.

Information Needs

In Colorado, more information is needed on population trends of mountain sucker (Belica and Nibbelink 2006). Movement patterns and habitat requirements are not well known for the species (Belica and Nibbelink 2006). Further, more studies are needed assessing the impacts of oil and gas development on mountain sucker. Lastly, future research should focus on understanding aspects of the community ecology of mountain sucker, such interaction and competition with non-native fish species.

Conservation Actions

Hybridization with non-native suckers is the most pressing conservation threat. Reaches that presently support mountain suckers and do not contain non-native suckers should be individually evaluated and all appropriate measures identified to ensure they remain uninvaded. Constructed barriers, in conjunction with mechanical or chemical removal, may be feasible in some streams, to open up additional habitat for re-introduction. Suppression of non-native predators, particularly northern pike and smallmouth bass, must continue throughout the basins where these species have invaded.

Northern Redbelly Dace (*Phoxinus eos*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development); Northern Redbelly Dace (*Phoxinus eos*): a technical conservation assessment (2006) (link in Appendix D).

Threats

The northern redbelly dace (*Phoxinus eos*) occurs in Canada, the northeastern United States, west to Montana. The southernmost populations occur in the South Platte River basin in Colorado, where it is listed as state endangered (CPW 2014). As a glacial relict species restricted to the transition zone along the Front Range, it is subject to a number of threats associated with urban development (Fausch and Bestgen 1997, and see “transition zone” description in Habitat section of this Plan). Since 1986, the species has only been documented in one area in Colorado: the West Plum Creek drainage south of Denver (Bestgen 1989; Nesler et al. 1997).

1 Residential & Commercial Development

The West Plum Creek drainage is located south of Denver near Sedalia, Colorado in Douglas County. The population of Douglas County has grown 7.2% from 2010 to 2013 (U.S. Census Bureau 2014). The West Plum Creek area is relatively close to Denver, and housing developments have been built since Bestgen (1989) confirmed the presence of northern redbelly dace in the area. This increased development may result in loss, degradation or fragmentation of occupied dace habitat. Reaches of St. Vrain Creek and the Big Thompson River where northern redbelly dace were historically collected have been impacted by urban development to a much greater extent.

7 Natural System Modifications

The northern redbelly dace is typically found in clear, spring-fed, low velocity streams and small ponds with cool water, high vegetation cover (Stasiak 1987; Wright 2011; Felts and Bertrand 2014). Impoundments, diversions groundwater pumping, and dams could degrade or fragment habitat by increasing turbidity, changing channel morphology, and dewatering and/or altering flows (Stasiak 2006). Stream channelization for flood control has greatly reduced the amount of permanent near-channel standing water or low-flow habitat for the species along the Front Range of Colorado (CPW 2014).

8 Invasives, Problematic Native Species, & Pathogens

Introduced fish species are considered a major threat to northern redbelly dace (Stasiak 2006). In the headwaters of the Niobrara River in Nebraska, northern redbelly dace may be declining due to the presence of stocked brown trout (*Salmo trutta*), northern pike (*Esox lucius*), bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus*) (Stasiak 1976; Stasiak 1989; Stasiak

2006). Western mosquito fish may negatively impact northern redbelly dace by displacement from its preferred thermal regime (Ciepiela et al. 2013).

Information Needs

Increased frequency of sampling, as well as studies on the hydrology and flow dynamics are needed in the W. Plum Creek area (Wright 2011).

Conservation Actions

Securing water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements) is a key priority. Continue efforts to identify additional potential re-introduction sites within the species' native range. Identify opportunities for habitat improvement to create or restore suitable habitat. Maintain the broodstock at NASRF and create additional populations through stocking when suitable habitat becomes available.

Orangespotted Sunfish (*Lepomis humilus*)

Threats

The orangespotted sunfish (*Lepomis humilus*) is widespread throughout the Central United States. In Colorado, it occurs in the Arkansas and South Platte River basins (Nesler et al. 1997; Nesler et al. 1999). Few studies have investigated the status and trends of orangespotted sunfish in Colorado.

7 Natural System Modifications

The orangespotted sunfish occurs in both lakes and streams on Colorado's Eastern Plains, and is tolerant of low flow conditions and high water temperatures (Tomelleri and Eberle 1990). However, tolerance thresholds for these harsh conditions are unknown. The dewatering of streams caused by groundwater pumping may be a threat to this species. In stream habitats the orangespotted sunfish prefers clear streams with rocky substrate, but is tolerant of brief periods of siltation (Tomelleri and Eberle 1990). Dams and diversions that alter both the creation and maintenance of these rocky beds and sediment concentrations could create less favorable habitat for species. Anecdotal observation suggests that declines may be associated with increased siltation (CPW unpublished data). The species also inhabits standing water—historically mostly near-channel floodplain ponds, which have decreased in availability through channelization, and often declined in quality due to contaminants and nutrients (Nesler et al. 1997). Although abundant new lentic habitat has been created for water storage and gravel mining, most of these waters contain largemouth bass and other centrarchids; it has been speculated that these may outcompete orangespotted sunfish based on size, aggressiveness and physiochemical tolerance (Propst 1982).

Information Needs

More information is needed on the habitat preferences, threats, and status of orangespotted sunfish in Colorado.

Conservation Actions

Secure water availability and habitat quality for existing populations, e.g., through easements and other landowner agreements. Identify potential ponds for broodstock maintenance, should that become necessary. Identify opportunities for habitat improvement to create or restore suitable habitat. Maintain the broodstock at NASRF and create additional populations through stocking when suitable habitat becomes available.

Orangethroat Darter (*Etheostoma spectabile*)

Threats

The orangethroat darter (*Etheostoma spectabile*) is widespread throughout the central United States. In Colorado, it is restricted to the far eastern side of the state in the Republican River Basin (Cancalosi 1980; Woodling 1985). The species is also found in Lodgepole Creek, in Wyoming, a tributary to the South Platte that joins the South Platte near Ovid, Colorado. One may surmise from this that the orangethroat darter historically also occurred in eastern portions of South Platte basin within Colorado, but it has never been collected there.

7 Natural System Modifications

Dewatering, primarily due to groundwater depletion, is an immediate or prospective threat for much of the Republican Basin within Colorado (Falke et al. 2011; McGuire 2011). The species is tolerant of warm water and able to withstand short periods of intermittent stream flow, taking refuge in small pools (Cross and Collins 1975). However, tolerance thresholds for the darter are unknown; it is likely that direct habitat loss and fragmentation for extended periods of time due to dewatering could negatively affect the species. The orangethroat darter prefers fast moving water and silt-free habitats (Pfleiger 1997). Dams and diversions create lentic habitats, block fish passage, and alter sediment concentrations, creating less favorable habitat for orangethroat darter (Woodling 1985).

Information Needs

Basic information is needed on life history and habitat preferences as they relate to potential impacts of fragmentation.

Conservation Actions

Securing water availability and habitat quality for existing populations, e.g., through easements and other landowner agreements, is a key priority. Identify reaches most likely to retain unfragmented, perennially-flowing water 30-50 years from now, and concentrate efforts to protect surface and groundwater in those areas.

Plains Minnow (*Hybognathus placitus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development); Plains Minnow (*Hybognathus placitus*): a technical conservation assessment (2005) (link in Appendix D).

Threats

The plains minnow (*Hybognathus placitus*) is a small, slender fish that occurs in the Great Plains region from Montana to Texas. In Colorado, it is found on the eastern plains, and is listed by the State of Colorado as endangered (CPW 2014). Specimens have been collected from the Republican River, South Platte River, and Arkansas River basins, but it is considered extremely rare in the state (Cancalosi 1980; Goettle 1981; Propst 1982; Woodling 1985; Scheurer 2002; CPW 2014). In the Arkansas River, CPW has recently (2013) initiated a stocking augmentation program. Little information is available on the distribution, life history, population trends, and community ecology of plains minnow (Rees, Carr, and Miller 2005a). This information is critical for the management and conservation of this species.

2 Incompatible Agriculture

Grazing by livestock has damaged 80% of the streams and riparian ecosystems in the western United States (USDOI 1994; Belsky et al. 1999). Erosion and siltation from cattle grazing can degrade habitat for native fishes (Scheurer and Fausch 2002). Although water quality parameters are undefined for this species, it is likely that a reduction in water quality could lead to a reduction in overall fitness of plains minnow (Rees, Carr, and Miller 2005a).

7 Natural System Modifications

Population declines in the Arkansas River (Kansas and Colorado) are associated with dewatering and changes in channel morphology (Cross and Moss 1987). These changes are caused by

groundwater pumping, diversions, impoundments, and land use practices that modify flow regimes (Rees, Carr, and Miller 2005a).

8 Invasives, Problematic Native Species, & Pathogens

Non-native fish species are likely to threaten the health and population of plains minnow through competition and predation (Rees, Carr, and Miller 2005a). However, there is a lack of research on the interactions between plains minnow and non-native fish species.

Information Needs

More sampling is needed in the Republican River, Arkansas River, and South Platte River basins to determine how much of this species' historic range is still occupied (Scheurer et al. 2003). More information is needed on the life history, ecology and habitat requirements of plains minnow (Rees, Carr, and Miller 2005a). Further studies are also needed examining the impacts of nonnative fish species on the plains minnow. Lastly, determining the response of the species to changes in stream flow is critical for informing management decisions on flow regimes (Rees, Carr, and Miller 2005a).

Conservation Actions

Establish a South Platte basin broodstock and initiate an augmentation stocking program in the South Platte Basin. Continue stocking in the Arkansas basin. Rigorously evaluate factors affecting survival and persistence, to increase success of future efforts. Identify opportunities for habitat improvement to create or restore suitable habitat.

Plains Topminnow (*Fundulus sciadicus*)

Threats

The plains topminnow (*Fundulus sciadicus*) is a Great Plains endemic. In Colorado, it occurs in the mainstem of the South Platte River and its tributaries (Woodling 1985). Population declines have been documented across its range (Weitzel 2002b). In 2013, the US Fish and Wildlife Service found the species not warranted for federal ESA listing or candidate status (USFWS 2013f). It has no special status in Colorado, although certain populations appear to have declined (CPW unpublished data), and it is vulnerable given its life history requirements. The primary threats to plains topminnow are competition with nonnative fish species, water management activities, urban and rural development, and intense livestock grazing (Rahel and Thel 2004b; Pasbrig et al. 2012; USFWS 2013f).

1 Residential & Commercial Development

Plains topminnow habitat has likely been lost or degraded due to the rapid development of the Front Range of Colorado (Nesler et al. 1997). Urban and ex-urban development in the Front Range corridor has caused stream channelization and water quality degradation.

2 Incompatible Agriculture

Across its range, the plains topminnow is most abundant in spring fed pools with clear water and high cover of macrophytes (Rahel and Thel 2004b). Intense cattle grazing can result in a loss of aquatic vegetation, as well as an increase in turbidity, therefore degrading plains topminnow habitat (Platts 1991; Rahel and Thel 2004b). Overgrazing can also lead to increased bank erosion and stream intermittency (Platts 1991).

7 Natural System Modifications

The decline in plains topminnow populations has been linked to the de-watering of critical backwater habitats from irrigation drawdown and drought (Haas 2005; Koupal and Pasbrig 2010). Although drought conditions are a common occurrence across the Great Plains, the lowering of ground water levels from irrigation pumping has increased the magnitude of stream de-watering (Fausch and Bestgen 1997; Dodds et al. 2004; Rahel and Thel 2004b). Plains topminnow are usually located in headwater and naturally intermittent reaches of prairie streams, and are therefore highly vulnerable to habitat loss from irrigation and water diversions that lower the water tables and in-stream flows (Rahel and Thel 2004b). They tend to prefer standing water or slow-moving habitat such as backwater, sloughs, or seasonally-connected near-channel habitat. These habitat types are particularly likely to be impacted by channel modification associated with water management and/or urban development.

8 Invasives, Problematic Native Species, & Pathogens

Several nonnative fish species have been suggested as potential predators and competitors of plains topminnow including largemouth bass (*Micropterus salmoides*) and, especially, Western mosquitofish (*Gambusia affinis*). In a laboratory experiment, western mosquitofish likely caused plains topminnow mortality by direct injury and competition for food resources (Haas 2005). Western mosquitofish could cause dramatic reductions in plains topminnow populations (Rahel and Thel 2004b; Haas 2005). Another study revealed that a shift in fish species assemblage over to generalist and nonnatives coincided with the loss of plains topminnow (Fischer and Paukert 2008). In Colorado, CPW researchers found a strong correlation between mosquitofish invasion and subsequent apparent disappearance of plains topminnow at invaded sites (CPW unpublished data).

Information Needs

More information is needed on basic life history traits, the roles of predation and competition, and mechanisms used by plains topminnow to re-establish populations after local extirpations (Rahel and Thel 2004b).

Conservation Actions

Secure water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements). Continue efforts to identify additional potential re-introduction sites within the species' presumptive native range. Sites that remain uninvaded by

Gambusia are especially important. Rigorously evaluate factors affecting success of translocations, to increase success of future efforts. Continue survey efforts to identify additional populations. Identify opportunities for habitat improvement to create or restore suitable habitat.

Razorback Sucker (*Xyrauchen texanus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Razorback Sucker (*Xyrauchen texanus*) Recovery Goals – Amendment and Supplement to the Razorback Sucker Recovery Plan (2002); Razorback Sucker (*Xyrauchen texanus*) Recovery Plan (1998) (links in Appendix D).

Threats

The razorback sucker (*Xyrauchen texanus*) was once common to abundant throughout the Colorado River Basin and its tributaries (Minckley 1991). In 1991, the razorback sucker was listed as Endangered throughout its entire range (USFWS 2002e). In Colorado, all extant populations are supplemented with stocked fish. Stocked fish survive well, with individual fish known to have persisted for over a decade post-release. Reproductive behavior and larval production are observed regularly in the Colorado River and more recently in the White (as well as in reaches outside of Colorado); however, evidence that wild-spawned fish survive to be juveniles or recruit to adulthood remains elusive. Threats to the species include streamflow regulation, habitat modification, competition with and predation by nonnative fish species, and pesticides and pollutants (USFWS 2002e).

2 Incompatible Agriculture

Irrigation has caused high selenium concentrations in upper Colorado River, the Gunnison River, and the San Juan River (Anderson et al. 1961). Selenium concentrations have been shown to be negatively correlated with egg diameter and percent hatch, and positively correlated with deformities in razorback suckers (Hamilton et al. 2005).

3 Energy Production & Mining

A large uranium mill tailings pile from the Atlas Mine near Moab, Utah poses two significant threats to endangered fish in the Colorado River: 1) toxic discharges of pollutants, particularly ammonia, enter the river through groundwater and are directly toxic to razorback sucker, and 2) risk of catastrophic pile failure could bury nursery areas and destroy fish habitat (Fairchild et al. 2002; USFWS 2002e).

4 Transportation & Service Corridors

The Denver and Rio Grande Western railroad tracks parallel the Colorado River at Black Rocks and Westwater Canyon. Potential hazardous waste spills resulting from a train derailment

threaten razorback sucker populations in these areas. A network of pipelines containing petroleum products cross or closely follow the Yampa River upstream of Yampa Canyon, none of which contain emergency shut-off valves (USFWS 2002e). Leaking or bursting pipes could result in deleterious effects to the fish community in the Yampa River.

7 Natural System Modifications

The construction of dams along the mainstem of the Colorado River and its tributaries has fragmented and inundated riverine habitat; released cold, clear waters; altered ecological processes and sediment regimes; affected seasonal availability of habitat; and blocked fish passage (Minckley and Deacon 1968; Marsh and Douglas 1997; Holden 1979; USFWS 2002e). Fish passageways have been created for the razorback sucker and other native fish at dam sites in the Colorado River near Palisade and on the Gunnison River (Landers 2012). The Green River Dam in Utah is slated for rehabilitation, and the final plans for renovation include a fish passageway to allow for the upstream and downstream movement of native fishes, including razorback sucker (USDOA 2014).

The razorback sucker evolved under the highly variable flows of the Colorado River before dams and impoundments were established. Adult razorback suckers spawn over clean cobble bars during spring runoff, and their larvae drift into floodplain habitats inundated during the spring floods (McAda and Wydoski 1980; Wick et al. 1982; USFWS 2002e). The dam-related changes in timing and flow levels on the Colorado River and its tributaries, along with channelization, have led to a loss of floodplain nurseries that are necessary for the survival and reproduction of the razorback sucker (McAda and Wydoski 1980). Re-creation of suitable nursery habitat (mostly in Utah) and timing of dam releases to coincide with razorback spawning appear to hold promise for meeting the razorback sucker's life history requirements despite the persistence of these threats (UCREFRP 2012).

8 Invasives, Problematic Native Species, & Pathogens

Numerous non-native species are reported as predators on the razorback sucker, including striped bass (Karam et al. 2008), common carp, green sunfish, largemouth bass, and flathead catfish (20+ authors, see citation list on pg. 23 of the Recovery Plan, USFWS 1998b). Smallmouth bass (*Microperus dolomieu*) northern pike (*Esox lucius*), walleye (*Sander vitreus*) and channel catfish (*Ictalurus punctatus*) have been identified as the foremost threats, along with burbot (*Lota lota*), an emerging new predator (Johnson et al. 2008). These non-native species are cited as the primary biological threat to the survival and reproduction of razorback sucker (USFWS 1998b).

Information Needs

More information is needed on suitable habitat for razorback sucker. Pesticides have been cited as a possible threat to the razorback sucker, but little to no research has been done investigating the effects of pesticides on the species. The severity of selenium impacts needs to be determined with much more certainty.

Conservation Actions

Suppression of non-native predators, particularly northern pike and smallmouth bass, must continue throughout the basins where these species have invaded. Recovery efforts for this species are coordinated primarily by the Upper Colorado Endangered Fish Recovery Program, in which Colorado is a partner agency.

Rio Grande Chub (*Gila pandora*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Rio Grande Chub (*Gila pandora*): a technical conservation assessment (2005) (link in Appendix D).

Threats

The Rio Grande chub (*Gila pandora*) was once widespread in New Mexico (Rio Grande and Pecos River basins), Colorado (upper Rio Grande and San Luis River basins), and Texas (Pecos River basin) (Zuckerman and Langlois 1990; Bestgen, Compton, Zelasko and Alves 2003; Rees, Carr, and Miller 2005b). In Colorado, overall numbers of individuals have been reduced by as much as 75% (Zuckerman and Langlois 1990; Bestgen, Compton, Zelasko and Alves 2003; Rees, Carr, and Miller 2005b). It is now considered a Species of Special Concern (CPW 2014). Major threats are degradation of habitat following dam and impoundment construction, predation by and competition with non-native fish species, heavy metals from natural sources and mining, and excessive grazing (Bestgen, Compton, Zelasko and Alves 2003; Rees, Carr, and Miller 2005b).

2 Incompatible Agriculture

The Rio Grande chub is commonly associated with aquatic macrophytes such as *Potamogeton*, woody debris, and overhanging riparian vegetation. Overgrazing in occupied habitat can lead to the degradation or elimination of these microhabitat types, and is thus cited as a possible threat to the species although studies are lacking (Calamusso and Rinne 1999; Bestgen, Compton, Zelasko and Alves 2003).

3 Energy Production & Mining

Heavy metals and cyanide from the Summitville Mine were released into the headwaters of the Alamosa River beginning in 1986 (Csiki and Martin 2008). These pollutants may be responsible for absence of fishes upstream and in Terrace Reservoir (Woodling 1995). In 1997, heavy metals from historic mines were flushed by a summer rainstorm into Kerber Creek. All fish in Kerber Creek died, along with 43% of the fish in a 4km stretch of San Luis Creek (Alves 1997a; Bestgen, Compton, Zelasko and Alves 2003). Rio Grande chub were known to occupy these two creeks, and continued monitoring of the site has shown a decline in numbers of individuals following the contamination event (Bestgen, Compton, Zelasko and Alves 2003).

7 Natural System Modifications

The construction of at least 56 large-scale dams along the entire length of Rio Grande River began in the late 1800s, and accelerated through the 1960s (Cowley 2006). These structures have homogenized and depleted flows, altered natural seasonal flow regimes (Molles et al. 1998), fragmented habitat, and interrupted fundamental processes such as sediment and nutrient transport (Ellis et al. 2001), causing a decline in the Rio Grande chub and other native fish species.

8 Invasives, Problematic Native Species, & Pathogens

Negative interactions with non-native species have been cited as one of the main contributing factors to the decline of the Rio Grande chub in the Carson and Santa Fe National Forests in northcentral New Mexico, close to the Colorado border (Calamusso and Rinne 1999). The species composition at occupied Rio Grande chub sites in Colorado was found to be dominated by non-native fish: the most common among these were fathead minnow (*Pimephales promelas*), white sucker (*Catostomus commersonii*), and red shiner (*Cyprinella lutrensis*), respectively (Bestgen, Compton, Zelasko and Alves 2003). All of these species are suspected to compete with or prey on the Rio Grande chub, although direct evidence is lacking.

Information Needs

Seasonal patterns and basic life history information for the Rio Grande chub is sorely lacking. Furthermore, there is little information available on predation by non-native species, as well as the dietary habits of the species. More studies are also needed to better understand the impact of grazing on Rio Grande chub. Lastly, earlier studies on the impacts of non-native species on Rio Grande chub have been conducted in New Mexico (Calamusso and Rinne 1996), but more investigation is needed within Colorado.

Conservation Actions

Provide additional security for existing populations where needed (e.g., through easements and other landowner agreements, barriers). Identify opportunities to extend length of available habitat for existing populations and, especially, to restore presumed metapopulations by connecting populations that are currently isolated. Identify additional potential re-introduction sites within the species' historic range, and aggressively pursue re-introduction opportunities.

Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Conservation Agreement for Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*) in the States of Colorado and New Mexico (2013); Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*) Conservation Strategy (2013); Rio Grande Cutthroat Trout

(*Oncorhynchus clarkii virginalis*): a technical conservation assessment (2006); Conservation plan for Rio Grande Cutthroat Trout (*Oncorhynchus clarki virginalis*) in Colorado (2004) (links in Appendix D).

Threats

The Rio Grande cutthroat trout (*Oncorhynchus clarkii virginalis*) occurs in the Canadian, Pecos and Rio Grande river basins in New Mexico and Colorado (Behnke 2002). It is the southernmost subspecies of *O. clarkii* (Pritchard et al. 2009). Rio Grande cutthroat trout populations have suffered serious declines in distribution, and the species presently occupies an estimated 11% of its historic range (USFWS 2014c), and remaining populations are restricted to high elevations and short stream segments (Alves et al. 2008). It was considered “warranted” for federal listing under the Endangered Species Act in 2008 (USFWS 2008), but was then removed from the candidate list in 2014 (USFWS 2014c). In Colorado, it is a species of special concern (CPW 2014).

Recent genetic studies have called into question traditional concepts regarding the taxonomy and distribution of cutthroat trout in Colorado (Metcalf et al. 2007; Metcalf et al. 2012; Bestgen, Rogers, and Granger 2013). Rio Grande cutthroat trout, however, remain a distinct subspecies limited to the Rio Grande basin of Colorado and New Mexico (Metcalf et al. 2012; Bestgen, Rogers, and Granger 2013). Microsatellite data has revealed “clear genetic differentiation between populations in the Rio Grande River and the Canadian and Pecos River drainages” and prompted the recommendation that these populations be conserved as evolutionary significant units (Pritchard et al. 2009).

7 Natural System Modifications

Wildfires in the range of Rio Grande cutthroat trout have depressed or eliminated fish populations (Japhet et al. 2007; Patten and Sloane 2007). Ash flows and debris from wildfires can wash into streams and cause fish kills (Rinne 1996; Brown et al. 2001). The watersheds occupied by Rio Grande cutthroat trout have a high risk of burning and causing high amounts of debris flow (Miller and Bassett 2013). The Rio Grande headwaters, however, have only a moderate risk of fire and debris flow compared to the rest of the species’ range (Miller and Bassett 2013).

8 Invasives, Problematic Native Species, & Pathogens

Non-native rainbow trout (*O. mykiss*) and other non-native cutthroat trout subspecies readily hybridize with Rio Grande cutthroat trout, resulting in introgression and loss of conservation populations (Pritchard and Cowley 2006; Alves et al. 2008). Other non-native fish species, including brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) have displaced or eliminated native cutthroat trout through competition and predation (Harig et al. 2000; Dunham et al. 2002; Peterson et al. 2004; Shemai et al. 2007).

Whirling disease has contributed to the collapse of wild trout populations in the western United States (Ayre et al. 2014). This disease damages the cartilage of infected fish, causes them to swim in a whirling motion. This altered state renders them incapable of feeding or avoiding predation (USFWS 2014c). Rio Grande cutthroat trout are predicted to have relatively low likelihood of infection (Ayre et al. 2014) compared to Colorado River cutthroat trout, but the disease is still considered a threat to the species (USFWS 2014c).

11 Climate Change & Severe Weather

Drought and increased stream temperatures have been identified as a major threat to Rio Grande cutthroat trout (Haak et al. 2010). Droughts in the southwestern United States are expected to increase in frequency and severity (Hoerling and Eischeid 2007). This could result in stream dewatering and a decrease in available habitat (Zeigler et al. 2012; USFWS 2014c). Average annual air temperature has increased across the range of Rio Grande cutthroat trout since the mid-20th century, and this trend could result in elevated stream temperatures that are unsuitable for Rio Grande cutthroat trout that rely on coldwater habitat to complete their life cycle (Williams et al. 2009; Ziegler et al. 2012; USFWS 2014c).

Information Needs

Unlike many of the rare fish species in Colorado, there is a relatively rich amount of information available on the Rio Grande cutthroat trout. The distribution of the species is fairly well understood (Alves et al. 2008). However, more surveys are needed to identify Rio Grande cutthroat trout conservation populations and characterize their habitat (RGCTCT 2013). More information is needed on the life history of the species, including spawning patterns and sex ratios. It is unknown if spawning occurs every year (RGCTCT 2013). Movement patterns of the species within small streams are largely unknown (Alves et al. 2008). Future research should also focus on assessing the effectiveness of restoration activities in occupied habitat.

Conservation Actions

Secure water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements). Increase the number of populations through re-introduction into suitable habitat. Continue efforts to identify additional potential re-introduction sites within the species' presumptive native range, including larger drainages with tributary streams. Sites that remain relatively free of non-native predators are especially important. Rigorously evaluate factors affecting success of current stocking efforts, to inform future stocking. Continue survey efforts to identify additional populations. Identify opportunities for habitat improvement to create or restore suitable habitat.

Rio Grande Sucker (*Catostomus plebeius*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Rio Grande Sucker (*Catostomus plebeius*): a technical conservation assessment (2005); State of Colorado Rio Grande Sucker Recovery Plan (1994) (links in Appendix D).

Threats

The Rio Grande sucker (*Catostomus plebeius*) is endemic to the Rio Grande Basin. The largest part of its range is in New Mexico, with smaller portions extending into Colorado and Mexico. Populations in Colorado declined precipitously during the 20th century, until surveys in 1994 confirmed that only one population remained in Hot Creek in Conejos County (Rees and Miller 2005). It is now listed as a state endangered species in Colorado, and was petitioned for federal listing in 2014. The primary threats to the species are 1) habitat loss through the dewatering of streams, 2) habitat fragmentation and movement barriers caused by dams and diversions, 3) changes in stream temperatures, water chemistry, and channel geometry, and 4) competition and predation by non-native fish species.

7 Natural System Modifications

The construction of at least 56 large-scale dams along the entire length of Rio Grande River began in the late 1800s, and accelerated through the 1960s (Cowley 2006). These structures have homogenized and depleted flows, altered natural seasonal flow regimes (Molles et al. 1998), fragmented habitat, and interrupted fundamental processes such as sediment and nutrient transport (Ellis et al. 2001), causing a decline in the Rio Grande sucker and other native fish species.

8 Invasives, Problematic Native Species, & Pathogens

Non-native fish species compete with, prey on, and hybridize with Rio Grande sucker. In the last 40 years, the non-native white sucker (*Catostomus commersonii*) has largely replaced the Rio Grande sucker in Colorado (Langlois et al. 1994). It has been suggested that competition between these two species for food, spawning sites, and rearing areas has negatively impacted the Rio Grande sucker (Rees and Miller 2005). Hybrids between these two species have been documented at Hot Creek, but rates were low, and hybridization does not appear to be a major factor in the decline of Rio Grande sucker in Colorado (Zuckerman and Langlois 1990; Swift-Miller et al. 1999). Other non-native fish species such as the brown trout (*Salmo trutta*) and northern pike (*Esox lucius*) are predators of the Rio Grande sucker.

Other Threats

The feeding habits of the Rio Grande sucker suggest a preference for streams with low turbidity and minimal sediment deposition (Swift-Miller et al. 1999a). However, land use changes such as

road construction, overgrazing, and timber harvest have led to increased sediment loads in Western streams (Judy et al. 1984; Rees and Miller 2005). There are no studies on the impact of these land use practices in occupied Rio Grande sucker habitat, but it is likely that high turbidity and sediment deposition from these activities has depleted and degraded the food supply for the species in Colorado (Swift-Miller et al. 1999b).

Information Needs

Seasonal patterns and basic life history information for the Rio Grande sucker is sorely lacking. More studies are needed to understand the habitat use patterns, diel movements, and life history events of the species. Future studies should also focus on the impacts of grazing, road construction, and culverts on Rio Grande sucker habitat.

Conservation Actions

Secure water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements, barriers). Continue efforts to identify additional potential re-introduction sites within the species' native range. Rigorously evaluate factors affecting success of current stocking efforts, to increase future success. Continue survey efforts to identify additional populations. Identify opportunities for habitat improvement to create or restore suitable habitat.

Roundtail Chub (*Gila robusta*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: State of Colorado conservation and management plan for the Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (in development); Range-wide conservation agreement and strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (2006); Roundtail Chub (*Gila robusta robusta*): a technical conservation assessment (2005) (links in Appendix D).

Threats

The roundtail chub (*Gila robusta*) was once common in the entire Colorado River Basin, but populations have declined in recent decades (Minckley and Deacon 1968; Carlson and Muth 1989; Osmundson 1999). In the portion of the upper Colorado River Basin located within Colorado, roundtail chub occupies approximately 55% of its historical range; it is declining or extirpated from sections of the Dolores, Gunnison, San Juan, and Green rivers (Bezzarides and Bestgen 2002; Bestgen et al. 2011). It is now considered a "species of special concern" in Colorado (CPW 2014). Population declines are more severe in the lower Colorado River Basin in Arizona and New Mexico, where the species is a Candidate for listing under the Endangered

Species Act (USFWS 2005). Budy et al. (2013) suggest that the roundtail chub is in grave decline in Utah. The primary threats to the species are flow alterations, physical habitat modifications, and the introduction of non-native fishes (USFWS 2002d; CPW 2014).

4 Transportation & Service Corridors

The Denver and Rio Grande Western railroad tracks parallel the Colorado River at Black Rocks and Westwater Canyon. Potential hazardous waste spills resulting from a train derailment threaten roundtail chub populations in these areas. A network of pipelines containing petroleum products cross or closely follow the Yampa River upstream of Yampa Canyon, none of which contain emergency shut-off valves (USFWS 2002d). Leaking or bursting pipes could result in deleterious effects to the fish community in the Yampa River.

7 Natural System Modifications

The construction of dams along the mainstem of the Colorado River and its tributaries has fragmented and inundated riverine habitat; released cold, clear waters; altered ecological processes and sediment regimes; affected seasonal availability of habitat; and blocked fish passage (Minckley and Deacon 1968; Valdez and Ryel 1995; Marsh and Douglas 1997; USFWS 2002d). Roundtail chub declines are common in impoundments after reservoir construction (Bezzarides and Bestgen 2002). Wolford Mountain Reservoir hosts the only reservoir-dwelling population of roundtail chub in Colorado (Ewert 2010). Fish passageways have been created for the roundtail chub and other native fish at dam sites in the Colorado River near Palisade and on the Gunnison River (Landers 2012). The Green River Dam in Utah is slated for rehabilitation, and the final plans for renovation include a fish passageway to allow for the upstream and downstream movement of native fishes, including roundtail chub (USDOA 2014).

Lowhead dams and constructed wetlands along Muddy Creek, a tributary of the Little Snake River in the Upper Colorado River basin, were shown to restrict downstream movement of roundtail chub and create novel wetland habitat favoring non-native fish species (Beatty et al. 2009). These dams and constructed wetlands, however, may have positive indirect effects as they create a barrier to the upstream spawning of non-native fish species that prey on, hybridize, and compete with the roundtail chub for resources. These findings highlight the complex impacts of dams on Colorado's native fish populations (Beatty et al. 2009).

The homogenization of flows in occupied roundtail chub habitat has led to an increase in continuous flatwater without the topographic and hydraulic heterogeneity required to create and support roundtail chub populations (Bestgen et al. 2011). Reductions in transport of fine sediment may also alter downstream geomorphic characteristics and availability of spawning sites and rearing habitat (Valdez and Ryel 1995; Van Steeter and Pitlick 1998; Douglas and Douglas 2000). Changes in discharge timing and magnitude may shift environmental cues

needed by fish for proper timing of migration and spawning, thereby preventing successful reproduction (Muth et al. 2000).

8 Invasives, Problematic Native Species, & Pathogens

Several non-native fish species are predators of the roundtail chub. A clear example was documented in the Yampa River between Hayden and Lily Park during 2000-2003, where the combined effects of drought conditions and increasing smallmouth bass (*Micropterus dolomieu*) and northern pike (*Esox lucius*) populations reduced habitat and recruitment of juvenile fish and increased predation on all size classes (Anderson and Stewart 2007). Negative effects of smallmouth bass on roundtail chub have also been documented in the Dolores River (White 2008; CPW 2010a). Non-native channel catfish (*Ictalurus punctatus*) were also abundant in eddies with roundtail chub in the Yampa and Green Rivers, and are likely predators of the chub (Karp and Tyus 1990).

The non-native Asian tapeworm (*Bothriocephalus acheilognathi*) has been implicated in the decline in the condition of humpback chub (*Gila cypha*) below Glen Canyon Dam (Meretsky et al. 2000). In 2005, an Asian tapeworm was documented for the first time in a roundtail chub (*Gila robusta*) in the Yampa River (Ward 2005). Potential impacts on the roundtail chub are unknown, though none have been observed.

Several members of the genus *Gila* reside in the Colorado River including humpback chub (*G. cypha*), roundtail chub (*G. robusta*), and bonytail chub (*G. elegans*). Recent research suggests that extensive introgressive hybridization has occurred within this group prior to the creation of dams and diversions (Gerber et al. 2001). However, it is also suggested that these human constructions have eliminated or compromised the realized niches of these species, and they now occur sympatrically (Douglas et al. 1998). Morphological characters can be used to separate out each taxon, but hybrids often possess intermediate characters. Hybrid intermediacy has led to inaccurate field identification. In Black Rocks and Westwater Canyon, researchers have documented higher proportions of roundtail chub during low flow years (Kaeding et al. 1990; Chart and Lentsch 2000). These low flow years result in increased sympatry between both chub species, and potentially increase the chances for hybridization (USFWS 2002d). Thus, it is necessary to mimic natural hydrological flow regimes to maintain natural proportions of *Gila* species and intergrades (USFWS 2002d).

Information Needs

More population surveys and life history studies on roundtail chub are needed in the upper Colorado River Basin, especially in smaller streams (Bezzarides and Bestgen 2002). Efforts should also focus on identifying and protecting important tributary streams from further flow alterations and habitat degradation (Bezzarides and Bestgen 2002).

Conservation Actions

Suppression of non-native predators, particularly northern pike and smallmouth bass, must continue throughout the basins where these species have invaded. Colorado's DRAFT Conservation and Management Plan for the 'three species,' which needs to be finalized, specifies additional conservation actions.

Southern Redbelly Dace (*Phoxinus erythrogaster*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development); Southern Redbelly Dace (*Phoxinus erythrogaster*): a Technical Conservation Assessment (2007) (link in Appendix D).

Threats

The southern redbelly dace (*Phoxinus erythrogaster*) is a small fish species that occurs throughout the Missouri River basin (Stasiak 2007). In Colorado, only two known wild populations exist. These occur in small tributaries to the Arkansas River near Pueblo, Colorado (Bestgen, Crockett, and Foutz 2013). Major threats to the species in Colorado are loss of habitat due to dewatering; habitat degradation due to impoundments, nonpoint source pollution, channelization and siltation; and non-native species.

2 Incompatible Agriculture

Excessive grazing in riparian zones can lead to erosion and siltation that compromises the cool, clear waters and clean gravels that are required habitat conditions for the southern redbelly dace (Platts 1991; Belsky et al. 1999). Increased turbidity from erosion and siltation interferes with the ability of the southern redbelly dace to spawn, feed, and recognize color patterns of potential mates (Rieman and Clayton 1997; Stasiak 2007).

7 Natural System Modifications

In the Arkansas River basin, the southern redbelly dace prefers small, cool, clear streams that are often spring-fed (Bestgen, Crockett, and Foutz 2013). Impoundments, dams, and diversions could degrade habitat for southern redbelly dace by altering flows, water chemistry and channel morphology (Stasiak 2007). Studies have shown that the species has a low tolerance to silt (Poff and Allan 1995) and does not survive well in reservoirs (Mammoliti 2002).

8 Invasives, Problematic Native Species, & Pathogens

Introduced predatory fish species may pose a serious threat to dace populations as they will consume even the largest adults (Stasiak 2007). The nonnative northern pike (*Esox lucius*), a large predatory fish, has been shown to reduce dace populations (He and Kitchell 1990).

9 Pollution

The southern redbelly dace has been reported as very sensitive to changes in water quality (Stagliano 2001). Pollutants and pesticides from agricultural runoff can degrade water quality, and these have been suggested as possible threats to the dace (Stasiak 2007).

Information Needs

More surveys are needed to discover new populations in Colorado, and to identify suitable habitat for re-introduction (Bestgen, Crockett, and Foutz 2013). Better characterize status, demographics and metapopulation dynamics of known populations, particularly the population nearest to the Arkansas River near Florence.

Conservation Actions

Securing water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements) is a key priority. Continue efforts to identify additional potential re-introduction sites within the species' native range. Identify opportunities for habitat improvement to create or restore suitable habitat. Maintain the broodstock at NASRF and create additional populations through stocking when suitable habitat becomes available.

Stonecat (*Noturus flavus*)

Threats

The stonecat (*Noturus flavus*) is widespread throughout the northern and central Great Plains, the Great Lakes region, and parts of the eastern United States. In Colorado, it is poorly documented with only two known sites. It has been reported from St. Vrain Creek, a tributary to the South Platte River, near the Longmont Wastewater Treatment Plant (Platania et al. 1986). It has also been collected from the North Fork of the Republican River in Yuma County, Colorado (Cancalosi 1980).

7 Natural System Modifications

Few studies have investigated threats to the species, but the dewatering of occupied streams, dams and diversions that block fish passage, and high sediment concentrations characteristic of Colorado's eastern plains streams are likely the primary threats to the species in Colorado (Woodling 1985).

Information Needs

Basic information on the life history, habitat preferences, and range in Colorado is needed.

Conservation Actions

Secure water availability and habitat quality for existing populations (e.g., through easements and other landowner agreements) is a key priority, particularly in the Republican basin. Increased

fragmentation of the St. Vrain population by post-flood reconstruction needs to be avoided to the extent possible, and its impact evaluated. Identify potential re-introduction sites within the species' native range. Study metapopulation dynamics, to understand importance of barriers and seasonal connectivity in life history, to direct future conservation activities.

Suckermouth Minnow (*Phenacobius mirabilis*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development).

Threats

The suckermouth minnow (*Phenacobius mirabilis*) is widespread throughout the Great Plains, the upper Midwest, and the Mississippi River basin. Historically, the species occurred on the eastern plains of Colorado in the South Platte, Arkansas River, and Republican River basins. The suckermouth minnow is presently rare in all of these basins, and may be extirpated from the Republican River in Colorado (Bestgen, Zelasko, and Compton 2003). In 2011, the suckermouth minnow was stocked into the Arkansas River near Rocky Ford, Colorado (CPW 2011). Few studies have investigated threats to the species, but the dewatering of occupied streams, as well as dams and diversions that block fish passage, are likely the primary factors limiting the distribution and abundance of the species in Colorado (Bestgen, Zelasko, and Compton 2003).

7 Natural System Modifications

Suckermouth minnows were commonly found in deep pools downstream of diversion dams on the South Platte River (Bestgen, Zelasko, and Compton 2003). Dewatering of streams has occurred on the Eastern Plains of Colorado, and naturally occurring deeper pools and runs have likely become rarer as a result. Presently, fish that rely on deep pools and eddies are often limited to those created by dams and impoundments. Therefore, dams likely have a complex effect on the species, at once blocking fish passage and creating deep pools that are favored by suckermouth minnow (Bestgen, Zelasko, and Compton 2003).

Information Needs

More studies are needed on 1) movement dynamics, 2) the role of mainstem and tributaries in sustaining populations, 3) the effects of stream channel geometry and fluvial processes on habitat, 4) habitat use during drought, and 5) the effects of water management practices (Bestgen, Zelasko, and Compton 2003). Lastly, more information is needed on the impact of nonnative fish species on suckermouth minnow.

Conservation Actions

Study movement and metapopulation dynamics, to understand importance of barriers and seasonal connectivity in life history, and to direct future conservation activities. Such studies are particularly important in the South Platte basin, to understand causes of dramatic population fluctuations not observed in the Arkansas basin. Identify potential re-introduction sites within the species' native range, emphasizing opportunities to protect or re-create mainstem-tributary connectivity, with availability of clean gravel substrate. Rigorously evaluate factors affecting success of current stocking to increase success of future efforts.

TIER 1 MAMMALS

American Pika (*Ochotona princeps*)

Threats

11 Climate Change & Severe Weather

CPW surveys in 2008 found that pika are well distributed in Colorado's high country. CPW's Predicted Range Model indicates extensive and largely contiguous suitable pika habitat in the state, suggesting that Colorado pika populations should have patch size and connectivity to maintain a metapopulation structure sufficient to preserve populations (Seglund 2008). The main concerns for climate change are that warming patterns could impact pika foraging rates, increase thermal stress on the animals, reduce snow cover used for insulation in winter, and alter plant communities impacting food availability and quality. Currently in Colorado, there is abundant alpine and subalpine habitat that may serve as a stronghold for the species as impacts from global climate change continue.

Information Needs

Continued evaluation of pika distribution and population levels is warranted to monitor the impacts of climate change.

Conservation Actions

Since baseline information has been collected, the next step is implementation of a long-term monitoring program that can evaluate changes in occupancy. This effort will allow managers to correlate changes in climate with changes in the distributions of pikas, vegetation, and thermal stress parameters.

Black-footed Ferret (*Mustela nigripes*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: A Cooperative Plan for Black-footed Ferret Reintroduction and Management, Wolf Creek and Coyote Basin Management Areas, Moffat and Rio Blanco Counties (2001); Black-footed Ferret Recovery Plan (1988) (links in Appendix D).

Threats

1 Residential & Commercial Development

The primary threat to black-footed ferrets is the loss of their prey base, prairie dogs (*Cynomys* spp.). There has been widespread conversion of native prairie dog habitat to residential and commercial development, particularly along the Front Range, but also throughout the ferret's historic range in Colorado.

2 Incompatible Agriculture

Approximately one-third of the overall historic range of ferrets has been converted to cropland that may accommodate ferrets but is inhospitable to prairie dogs (USFWS 2009). Prairie dogs have been lost to habitat conversion, rodenticide use and other eradication efforts, and disease (USFWS 2009).

8 Invasives, Problematic Native Species, & Pathogens

Sylvatic plague is a significant threat to remaining prairie dog colonies. Plague and canine distemper have impacted ferret re-introduction efforts and ferret prey populations. Both plague and canine distemper have motivated immunization strategies to improve success of re-introduction efforts.

14 Natural Factors

Ferrets are known to have undergone a genetic bottleneck when populations dwindled dramatically in the 1980s (Wisely et al. 2002). Despite re-introduction of 3,500 ferrets at 21 locations throughout the range (Black-footed Ferret Recovery Implementation Team, www.blackfootedferret.org), the species is still susceptible to genetic inbreeding limitations and stochastic demographic events that could impact populations.

Information Needs

Being one of the most charismatic endangered species ever to receive conservation attention, the species has been well studied. In Colorado, the biggest information gap is where ferret populations could be re-established and successfully sustained. This requires an understanding of the health and stability of the prey base population to support ferrets.

Conservation Actions

Conservation of the black-footed ferret in Colorado will depend on two main issues – control of disease and identification of relocation sites. There is on-going research into the development of a vaccine for sylvatic plague which is effective at protecting prairie dogs in the wild. This work will increase the success of ferret re-introduction rangewide. At the same time, it is important to work with various agencies and private landowners to identify potential re-introduction sites throughout the state. This will include both public outreach on the importance of prairie ecosystems and support for participating landowners. Overcoming social intolerance of prairie dogs is a hurdle. This can generally be overcome with large enough financial incentives such as those currently offered in the black-footed ferret Environmental Quality Incentives Program project occurring currently in Colorado.

Fringed Myotis (*Myotis thysanodes*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Colorado Bat Conservation Plan (2004); Fringed Myotis (*Myotis thysanodes*): a technical conservation assessment (2004) (links in Appendix D).

Threats

3 Energy Production & Mining

In Colorado, mines are used by the fringed myotis for day and night roosts (Armstrong et al. 2011) as well as maternity and transition roosts, which have been documented during the CPW's Bats and Inactive Mines Project. Any loss of roosting habitat is detrimental. Renewed mining in historic districts, especially for uranium, has the potential to displace this species from current roosting sites.

6 Human Intrusions & Disturbance

The fringed myotis will use buildings, caves, and mines for maternity roosts, night roosts, and hibernacula (Keinath 2004; Armstrong et al. 2011). Disturbances to mines and caves, such as abandoned mine closure, recreational caving, and renewed mining, are a threat to this species and can take the form of. In some areas, the fringed myotis will use tree snags as roosts (Keinath 2004); thus, removal of these resources, especially on a large scale, could be detrimental to this species.

Work & Other Activities

As abandoned mines throughout Colorado are closed for hazard abatement, there is potential for loss of bat roosts. Improper gate designs or closure during the wrong season or with inadequate pre-closure survey has the potential to have large cumulative effects on fringed myotis.

Recreation

Roosting bats are sensitive to disturbance and could leave roost sites following human visitation (Keinath 2004). Recreational caving can disrupt bats that use caves as roosts. Disturbance to roosting bats may not be intentional and may occur unbeknownst to the caver, but may cause abandonment of sites and the premature expenditure of critical fat reserves during hibernation (Thomas 1995).

8 Invasives, Problematic Native Species, & Pathogens

White-nose syndrome is a disease of hibernating bats caused by an introduced fungus (*Pseudogymnoascus destructans*) (Lorch et al. 2011; Warnecke et al. 2012) that has severely impacted bat populations in eastern North America (Frick et al. 2010). The fringed myotis could be susceptible to white-nose syndrome. White-nose syndrome has not been observed in Colorado, but because of the devastating impact to bat populations in eastern North America and its expansion across the continent as far west as the Kansas/Missouri border, this disease is a formidable threat to hibernating bat species. All indications are that many bat roosts in Colorado could provide the conditions suitable for *P. destructans*.

9 Pollution

The fringed myotis feeds on a wide variety of insects compared to many bat species (Keinath 2004; Armstrong et al. 2011). Large scale use of pesticides may reduce this species' prey base, but because of its broad diet, insect control programs focusing on one group of species may not have as severe of an effect. Bioaccumulation of toxins during foraging in bats may occur due to pesticide use. No studies have directly evaluated the effects of pesticide use on the fringed myotis, but work on other bat species in Colorado (O'Shea et al. 2001) and elsewhere have shown that bats accumulate high levels of contaminants in their tissues relative to other taxa (Clark and Shore 2001).

Information Needs

In their list of suggested research needs for the bats of Colorado, Ellison et al. (1999) mention the need for an intraspecific genetic analysis of subspecies in addition to general information gaps for all bat species. Little is known regarding winter ecology at hibernacula, seasonal movements, and adult male life history for this species. Data specific to Colorado regarding distribution, population status, and trends are lacking.

Conservation Actions

Protection of roosting bats from human disturbance, especially at significant winter hibernation sites and summer maternity sites, is important for the conservation of the fringed myotis. Developing a better understanding of the distribution and habitat use of the fringed myotis will better inform which sites are at greatest risk from human disturbance, as well as what threat white-nose syndrome presents to this species.

Gunnison's Prairie Dog (*Cynomys gunnisoni*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy (2010); Gunnison's Prairie Dog Conservation Assessment (2005) (links in Appendix D).

Threats

2 Incompatible Agriculture

Prior to agricultural conversion of habitats in Colorado, many Gunnison's prairie dog populations occurred in habitats that provided deep soils and high quality forage – the same sites that agricultural producers preferred. Settlement of Colorado in the early 20th century saw rapid development of irrigated crops. As the century progressed, alfalfa and hay crops began to dominate the landscape. Replacement of native arid landscapes with highly nutritious legume and grass crops allowed prairie dog colonies in these areas to reach artificially high densities. However, these areas also resulted in the creation of more widely distributed, small colonies due to active eradication efforts and development of barriers such as fences, irrigation, roads, and urban predators. Though Gunnison's prairie dog colonies are being maintained in this new biological arrangement, their ecological function has been impaired.

5 Biological Resource Use

Recreational shooting results in direct mortality of targeted prairie dogs. Effects within individual colonies can be significant, but recreational shooting activity is irregularly dispersed across the range of Gunnison's prairie dogs. As a result, it is not expected that shooting alone can have a sufficient population level effect to move Gunnison's prairie dogs towards extinction. Nevertheless, where recreational shooting activity occurs regularly or at high intensity, shooting has the potential to locally reduce prairie dog densities and slow recovery rates of colonies impacted by plague or other disturbances, especially in the case of isolated colonies. Seasonal shooting closures have been implemented on public land to maintain recreational shooting mortality within acceptable limits for conservation of prairie dog populations.

8 Invasives, Problematic Native Species, & Pathogens

The primary factor limiting Gunnison's prairie dog populations and distribution in Colorado is sylvatic plague, an introduced, flea-transmitted disease caused by the bacterium *Yersinia pestis* (Seglund and Schnurr 2009). Plague is thought to be the most critical threat to sustained conservation of prairie dog species (Cully and Williams 2001; Pauli et al. 2006). CPW is currently testing an oral plague vaccine that can help protect prairie dogs from devastating outbreaks. In addition, CPW is dusting prairie dog colonies that are of conservation concern with an insecticide to reduce the potential of epizootics.

11 Climate Change & Severe Weather

Gunnison's prairie dogs evolved to live in arid areas that experience periodic droughts. However, human-facilitated changes in ecosystems in the west, including altered plant species composition, ecosystem function, and ecosystem structure (Fleischner 1994) may cause prairie dogs to be more susceptible to drought conditions. In addition, climate change may be increasing the number and duration of drought events, making it more difficult for prairie dogs to survive. When Colorado experienced an extreme drought in 2002, many Gunnison's prairie dog colonies were lost.

Information Needs

Methods for how to manage plague at a landscape scale and at colonies or complexes that are of conservation concern are needed.

Conservation Actions

The primary conservation actions needed include continued dusting of colonies to protect against plague events, continued work on the oral plague vaccine, and continued occupancy surveys to evaluate status of the species statewide. Strategies outlined in the Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy (Seglund and Schnurr 2009) should be implemented. Management of rangelands needs to consider the relative influence of climate change. While there are many uncertainties about how climate change will affect certain habitats, an overall management strategy that maintains a larger intact landscape, and thereby increases the ability of the given species to adjust their range, should be incorporated in the overall conservation of the species.

Little Brown Myotis (*Myotis lucifugus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Colorado Bat Conservation Plan (2004) (link in Appendix D).

Threats

5 Biological Resource Use

Little brown myotis will use buildings and other structures during different times of the year (Armstrong et al. 2011), and are often found in close proximity to urban and suburban areas in Colorado. This is especially true during the maternity season, when nursery colonies are often found in the warm attics of buildings. Exclusion or extermination of bats from roost sites that are inhabited by humans and, if not done properly or during an appropriate time of year, can be a threat to this species.

8 Invasives, Problematic Native Species, & Pathogens

White-nose syndrome is a disease of hibernating bats caused by an introduced fungus (*Pseudogymnoascus destructans*) (Lorch et al. 2011; Warnecke et al. 2012) that has severely impacted bat populations in eastern North America (Frick et al. 2010). To date, the little brown myotis is one of the species most impacted by white-nose syndrome, and is at risk of local extinction in eastern North America (Frick et al. 2010). Local population declines at hibernacula of over 50% per year, with some reaching as high as 99%, have been reported (Frick et al. 2010). White-nose syndrome has not been observed in Colorado, but because of the devastating impact to bat populations in eastern North America and its expansion across the continent as far west as the Kansas/Missouri border, this disease is a formidable threat to hibernating bat species. All indications are that many bat roosts in Colorado could provide the conditions suitable for *P. destructans*.

Information Needs

The little brown myotis is one of the better studied bat species in North America, but information is still lacking on population dynamics and populations status, especially within Colorado. Most of the known roosts in Colorado are maternity colonies, which are comprised primarily of females and their young and typically contain fewer than 100 adult females (Armstrong et al. 2011). Little information is known regarding male roosting habits. Data on seasonal movements and hibernacula locations and status are needed. Large hibernacula, as might be found in eastern North America, are not known from Colorado, and more information is needed on the winter ecology of this species.

Conservation Actions

Protection of roosting bats from human disturbance and take, especially at significant winter hibernation sites and summer maternity sites, is important for the conservation of the little brown myotis. Developing a better understanding of the distribution and habitat use of the little brown myotis will better inform which sites are at greatest risk from human disturbance, as well as what threat white-nose syndrome presents to this species. Sustained monitoring of summer colonies and acoustic monitoring statewide are needed to provide surveillance of the potential arrival of white-nose syndrome into the state.

Lynx (*Lynx canadensis*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Federal listing documents; Recovery outline (links in Appendix D).

Threats

Lynx have successfully been re-established in Colorado and a self-sustaining population is believed to persist in the region. The management actions taken to re-establish the population to Colorado were done considering the landscape of the time – there is no intention of attempting to change, alter or remove historic and current land uses from the landscape. Many of these industries can and have developed practices that have the potential to allow the long term persistence of the lynx within the context of existing land use.

5 Biological Resource Use

The characteristics of vegetation structure that makes habitat suitable for lynx have been shaped by fire, insects and diseases in the western United States (Ruggiero et al. 1999). When lynx ecology is not taken into consideration, commercial timber harvest within the range occupied by lynx has the potential, when done at relevant scales, to disrupt this structure, rendering the post-harvest habitat unsuitable for lynx and/or their primary prey, snowshoe hares. The establishment of dense small tree and shrub cover is essential for hare populations to reoccupy harvested areas.

Forest harvesting may contribute to fragmentation of lynx habitat, as does construction of highways and associated infrastructure, and mineral or energy development (Ruggiero et al. 1999). Fragmentation can affect lynx by reducing their prey base and by creating patches of foraging habitat that are too small and too distant from each other to support viable populations of lynx (Buskirk et al. 2000).

7 Natural System Modifications

Natural wildfire has maintained a dynamic mosaic of varying age classes of forest stands that provides habitat for both snowshoe hare and lynx (Slough and Mowat 1996). In the Rocky Mountains, the historic fire regime was variable, with both frequent (35–100 years) stand-replacing or mixed-severity fires, and infrequent (200+ years) stand-replacement fires (Hardy et al. 1998). Starting about 100 years ago, this natural fire regime was disrupted by fire suppression efforts, leading to dense forests. This, combined with recent droughts and increasing temperatures, has resulted in a recent shift to uncharacteristically severe and intense wildfires in lower-elevation forests (Morgan et al. 1998). There is the potential for these fires to increase in frequency in the future and spread into adjacent areas occupied by lynx, causing the loss of large expanses of lynx habitat.

11 Climate Change & Severe Weather

The impact of climate change on lynx is uncertain and unquantified. The predicted effects of climate change in the West include a reduced snowpack and shorter periods of snow cover, snowmelt that occurs earlier in the season, a hydrologic cycle that is more dynamic as extreme rainfall events occur with greater frequency and overall warmer, drier, and more drought-like

conditions (Melillo 2014). While it is uncertain when these effects may take place and the magnitude of their impact on lynx, the effects of these changes may include changes in population distribution and size, amount of habitat, demographic rates, and predator prey relationships (Ruggiero et al. 1999). The extent to which any of these possible changes may impact the population as a whole is unknown. Management actions have little ability to alter the predicted impacts or even mitigate the effects of climate change. However, assessments to identify possible avenues for adaptive management strategies to climate change should be considered (Ruggiero et al. 1999).

Information Needs

High priorities for research include continued monitoring of lynx populations in suitable habitat to verify population trends, distribution, and population viability, as well as to validate core areas classified and mapped as suitable habitat for lynx. Other research needs include assessing the effect of climate change on lynx, lynx habitat and snowshoe hare; further refinement of survey protocols; researching what effect vegetation management has on lynx distribution and density; examining the limits to lynx dispersal; investigating how silvicultural practices impact snowshoe hares, evaluating how winter recreational activities impact lynx behavior and habitat use; and determining what role secondary and peripheral areas have in the conservation of lynx.

Conservation Actions

The primary action needed for the recovery of lynx is the drafting and implementation of a Federal Recovery Plan. Establishing recovery goals, objectives, and funding sources with the ultimate goal of delisting the species is paramount. Related, identifying and implementing survey protocols to assess occupancy trends for the species throughout the state is an important task. Identifying important movement corridors and implementing appropriate land management within those areas is important to allow for further dispersal and colonization throughout the state.

New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Federal listing documents (link in Appendix D).

Threats

7 Natural System Modifications

The primary threat to New Mexico jumping mouse populations is the loss and fragmentation of habitat from human land uses, including: incompatible grazing, recreational development and activity, climatic variability and stochastic events (Frey and Malaney 2009), transportation development, suburban development, loss of beaver and beaver ponds, coalbed methane

development, and instream changes due to increased runoff and flood control efforts. These human land use activities affect this species by removing protective cover, nests, food resources, and hibernation sites; disrupting behavior; or acting as a barrier to movement (USFWS 2013b).

14 Natural Factors

Isolation of populations may disrupt gene flow and create unpredictable genetic effects that could impact meadow jumping mouse persistence in a given area. The distribution of the New Mexico jumping mouse is so limited that they are already known to be susceptible to stochastic events, such as wildfire (Frey and Malaney 2009).

Information Needs

There are limited data on the genetic diversity of New Mexico meadow jumping mouse populations in Colorado, and the degree of similarity between Colorado and New Mexico populations. Only two populations from one location each were assessed in Malaney et al. (2012). Additionally, there is little known about the overall distribution of this species in Colorado. Surveys to better document distribution in Colorado are needed, especially in the San Luis Valley.

Conservation Actions

Further genetic comparisons would illustrate the divergence or lack thereof among Colorado populations. Continued surveying (especially in areas with high probability of occurrence), as well as revisits to known Colorado locations, would be valuable to document distribution and stability, and to conduct population monitoring. Protection of known habitat from both human disturbance and increased natural changes, such as fire, is important to the continued persistence of this species in Colorado.

Olive-backed Pocket Mouse (*Perognathus fasciatus*)

There are two subspecies of olive-backed pocket mouse (*Perognathus fasciatus*) in Colorado. In the northwest corner of Moffat County, *P. f. calistus* is restricted to the area north of the Yampa River (Armstrong et al. 2011). *Perognathus f. infraluteus* is restricted to a narrow band that extends from the border of Wyoming in Larimer and Weld counties southward through Huerfano County (Armstrong et al. 2011). Through a targeted inventory, Siemers et al. (2003) were able to find two new populations of *P. f. infraluteus*, but did not find them to be particularly abundant in grassland habitats. *Perognathus f. calistus*' range is considerably smaller than *P. f. infraluteus*' only extending into the northeastern edge of Utah and the southwestern Wyoming. Finley and Bogan (1995) considered the *P. f. calistus* common at locales in northwestern Colorado; however, the range is restricted and alterations to grasslands and desert-scrub communities in this region may keep populations isolated.

Threats

1 Residential & Commercial Development

For *P. f. infraluteus*, much of the western range overlaps the urban corridor of the Front Range, and it is likely that much grassland habitat for this subspecies has been lost.

2 Incompatible Agriculture

Little is known about either subspecies of *P. fasciatus* in Colorado, but conversion to cropland, prairie dog removal, and incompatible grazing patterns have likely altered grassland and desert-scrub habitats.

Information Needs

Many less-common rodent species are poorly understood, but ecology and population structure data for *P. fasciatus* in Colorado is particularly scarce. Little to nothing is known about overall distribution, patterns in distribution, abundance and changes in abundance, and impacts from urban/suburban development, grazing, prairie dog removal, and grassland structure alterations (Manning and Knox 1988; Armstrong et al. 2011).

Conservation Actions

The primary conservation actions needed for this species are development and implementation of a monitoring plan to improve understanding of population status, and protecting habitat from conversion to other uses.

Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Draft Recovery Plan Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) (2003) (link in Appendix D).

Threats

1 Residential & Commercial Development

The primary threat to Preble's meadow jumping mouse populations is the loss and fragmentation of habitat from human land uses, including urban, suburban, and recreational development; highway and bridge construction; water development; instream changes due to increased runoff and flood control efforts; sand and gravel mining; and overgrazing. These human land use activities affect this species by directly destroying its protective cover, nests, food resources, and hibernation sites; disrupting behavior; or acting as a barrier to movement (PMJM Recovery Plan Draft 2010).

14 Natural Factors

Scarcity

Isolation of populations may disrupt gene flow and create unpredictable genetic effects that could impact Preble's meadow jumping mouse persistence in a given area. While stochastic events are not known to be an immediate threat to jumping mouse populations, the tendency for Preble's numbers to vary widely over time heightens concern for small and isolated populations (PMJM Recovery Plan Draft 2010).

Competition

The relative ranges, abundances, and relationship between Preble's meadow jumping mouse and native and non-native small mammals may lead to competitive disadvantages for Preble's meadow jumping mouse. Being greatly outnumbered in abundance by North American deer mice (*Peromyscus maniculatus*) and meadow voles (*Microtus pennsylvanicus*), the jumping mouse may experience competitive disadvantages as habitats are altered (Schorr 2012). Additionally, as habitats are fragmented and encroached upon, there will likely be greater influx of non-native mammals, such as house mice (*Mus musculus*) and Norway rats (*Rattus norvegicus*), that may compete for resources.

Predation

As urban and suburban development encroaches on Preble's meadow jumping mouse habitat, there will be an increase in domesticated predators (domestic cats) and urban-associated meso-predators, such as red fox (*Vulpes vulpes*) and raccoon (*Procyon lotor*) (Woods et al. 2003, Ditchkoff et al. 2006). Increased predation from domestic and urban-associated carnivores diminishes the stability of jumping mouse populations.

Information Needs

There are few studies that have investigated the impacts to Preble's meadow jumping mouse populations when habitat is removed by either human (e.g., development) or natural (e.g., floods) means. Most threats are attributed to the loss of habitat because jumping mouse populations are no longer found or are constricted in areas that have been impacted. Multi-year studies that assess the impacts to Preble's meadow jumping mouse populations when habitat is removed would clarify how habitat alterations change jumping mouse populations.

Conservation Actions

Protection and improvement of existing habitat, especially through Best Management Practices, zoning, conservation easements, and habitat restoration, will improve the outlook for this species in Colorado. The revised recovery plan (currently in development and scheduled for completion in 2015) will inform the specific actions necessary for the long-term protection of individual populations throughout the state.

Spotted Bat (*Euderma maculatum*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Spotted Bat (*Euderma maculatum*): a technical conservation assessment (2007); Colorado Bat Conservation Plan (2004) (links in Appendix D).

Very little is known about the ecology and distribution of the spotted bat in Colorado. Spotted bats are difficult to capture and are often under-sampled in mist net surveys. Most information is from acoustic surveys of foraging sites (Navo et al. 1992; Storz 1995), but recent captures of this species have been made (Siemers and Schorr 2006; Bogan and Mollhagen 2010) and maternity colonies have been documented (O'Shea et al. 2011) in Colorado. Threats listed below are primarily speculative and based on potential activities that may adversely affect this apparently rare species. Roost sites are typically in remote locations that are isolated from most human activities. However, this species forages over many different habitat types that are adjacent to cliff and canyon roosting habitat, and the species is known to travel great distances during nightly foraging bouts. Therefore, potential threats to these other habitat types can potentially be impacting this species.

Threats

2 Incompatible Agriculture

Large scale use of pesticides for control of grasshoppers or Mormon crickets may reduce the prey base for spotted bats. Additionally, bioaccumulation of toxins during foraging in spotted bats may occur due to pesticide use. No studies have directly evaluated the effects of pesticide use on spotted bats, but work on other bat species in Colorado (O'Shea et al. 2001) and elsewhere have shown that bats accumulate high levels of contaminants in their tissues relative to other taxa (Clark and Shore 2001).

6 Human Intrusions & Disturbance

Rock climbing may affect this species on a local level. Cliff faces and rock crevices where this species roosts could be disturbed by recreational activity. This species has been reported to abandon roosts because of noise (Easterala 1973), and continued disturbance near climbing routes that receive frequent use may cause spotted bats to abandon roosts.

Information Needs

Basic life history and distributional information on the spotted bat is needed for Colorado. More information on reproduction, habitat use, seasonal movement patterns and abundance, among other factors, is needed for this species. Clarification of winter distribution is particularly needed.

Conservation Actions

The primary conservation action needed for the spotted bat is research into the distribution, habitat use, and population parameters in Colorado. This information will better inform which roost sites are at greatest risk from human disturbance, as well as what other threats may arise for this species.

Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Townsend's Big-eared Bat (*Corynorhinus townsendii*): a technical conservation assessment (2006); Colorado Bat Conservation Plan (2004) (links in Appendix D).

Threats

3 Energy Production & Mining

Because mines are a critical resource for this species and loss of roosts is thought to be a limiting factor (Pierson et al. 1999), any loss of roosting habitat is detrimental. Hibernacula, maternity, day, night, and transition roosts have all been documented in mines and caves in Colorado. Renewed mining in historic districts, especially for uranium, has the potential to displace Townsend's big-eared bats from current roosting sites.

6 Human Intrusions & Disturbance

Townsend's big-eared bat is most often associated with caves and mines, although it has been found to roost in abandoned buildings and rock crevices during some times of the year (Armstrong et al. 2011). Disturbances to mines and caves are the primary threat to this species, and can take the form of abandoned mine closure, renewed mining, and recreational caving.

Work & Other Activities

As abandoned mines throughout Colorado are closed for hazard abatement, there is potential for loss of bat roosts. Mines are a critical resource for Townsend's big-eared bats in Colorado. Improper gate design, and closure during the wrong season or with inadequate pre-closure survey, have the potential to have large cumulative effects on this species.

Recreation

This species is sensitive to disturbance and will leave roost sites following human visitation (Armstrong et al. 2011, Pierson et al. 1999). Disturbance to roosting bats may not be intentional and may occur unbeknownst to the caver, but can cause abandonment of maternity sites (Pierson et al. 1999 and references therein) and the premature expenditure of critical fat reserves during hibernation (Thomas 1995).

8 Invasives, Problematic Native Species, & Pathogens

White-nose syndrome is a disease of hibernating bats caused by an introduced fungus (*Pseudogymnoascus destructans*) (Lorch et al. 2011; Warnecke et al. 2012) that has severely impacted bat populations in eastern North America (Frick et al. 2010). The Townsend' big-eared bat could be susceptible to white-nose syndrome. White-nose syndrome has not been observed in Colorado, but because of the devastating impact to bat populations in eastern North America and its expansion across the continent as far west as the Kansas/Missouri border, this disease is a formidable threat to hibernating bat species. All indications are that many bat roosts in Colorado could provide the conditions suitable for *P. destructans*.

9 Pollution

Townsend's big-eared bat is a moth specialist (Pierson et al. 1999); thus, large scale use of pesticides for control of lepidopterans such as spruce budworms or gypsy moths, may reduce this species' prey base. Additionally, bioaccumulation of toxins during foraging in bats may occur due to pesticide use. No studies have directly evaluated the effects of pesticide use on Townsend's big-eared bat, but work on other bat species in Colorado (O'Shea et al. 2001) and elsewhere have shown that bats accumulate high levels of contaminants in their tissues relative to other taxa (Clark and Shore 2001).

Information Needs

The identification and protection of significant roost sites, especially maternity roosts and hibernacula, are needed for this species. Basic life history information such as foraging requirements, roost switching, and seasonal movement patterns within Colorado is also lacking. Of the known maternity and hibernation sites in Colorado, most support relatively few individuals (less than 25) (Pierson et al. 1999), which makes population monitoring a challenge. Information on trends and population status in Colorado is needed.

Conservation Actions

Protection of roosting bats from human disturbance and take, especially at significant winter hibernation sites and summer maternity sites, is important for the conservation of the Townsend's big-eared bat. Developing a better understanding of the distribution, habitat use, and population trend of the Townsend's big-eared bat will better inform which sites are at greatest risk from human disturbance, as well as what threat white-nose syndrome presents to this species. The development of a coordinated monitoring strategy/plan by relevant state and federal agencies for the protected mines and caves should be considered. There are currently over 800 bat gates installed in the state, under stewardship of state and federal agencies, which need to be monitored for conditions and status. Without this coordinated and cooperative conservation action, the benefit of past conservation actions could be lost.

White-tailed Prairie Dog (*Cynomys leucurus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy (2010); White-tailed Prairie Dog (*Cynomys leucurus*): a technical conservation assessment (2006) (links in Appendix D).

Threats

1 Residential & Commercial Development

Urbanization causes direct eradication and permanent loss of prairie dogs and their colonies, resulting in fragmentation and isolation of populations. Indirect effects of urbanization are poisoning or other control efforts deemed appropriate for human health and safety, predation from domestic pets, and increased vigilance and concealment behavior by prairie dogs in response to recurring disturbance in and around colonies (Magle et al. 2005).

3 Energy Production & Mining

Impacts due to energy development, particularly oil and gas, on white-tailed prairie dogs are not fully understood. It is thought, however, that there can be both indirect and direct impacts to the species from energy development activities, and that entire localized prairie dog systems may be affected. Due to the pace of energy development and the potential risk to the species, management actions need to be developed and implemented to protect these species and their habitats. Adaptive management will be needed to determine if management actions are effective or if modifications need to be made to ensure maintenance of the species and system health. See Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy (Seglund and Schnurr 2009) for a detailed list of strategies to implement for oil and gas.

5 Biological Resource Use

Recreational shooting results in direct mortality of targeted prairie dogs. Effects within individual colonies can be significant, but recreational shooting activity is irregularly dispersed across the range of white-tailed prairie dogs. As a result, it is not expected that shooting alone can have a sufficient population level effect to move white-tailed prairie dogs towards extinction. Nevertheless, where recreational shooting activity occurs regularly or at high intensity, shooting has the potential to locally reduce prairie dog densities and slow recovery rates of colonies impacted by plague or other disturbances, especially in the case of isolated colonies. Seasonal shooting closures have been implemented on public land to maintain recreational shooting mortality within acceptable limits for conservation of prairie dog populations.

7 Natural System Modifications

Alteration in fire regimes within the range of the white-tailed prairie dogs has produced changes in structure and function of plant communities. Fire is thought to be beneficial for prairie dogs because it can: (1) reduce the shrub component of shrub-steppe communities, leading to more open tracts of habitat and increased visibility; (2) release plant nutrients, temporarily increasing the nutrient content of forage; (3) stimulate fruit and seed production and increase the yield and quality of herbaceous vegetation; and (4) remove unwanted vegetative litter, which can increase the suitability of an area for prairie dogs (CNHP 2000; BLM 2001b; NRCS 2001; BLM 2002d in Buys and Associates Inc. 2005).

8 Invasives, Problematic Native Species, & Pathogens

The primary factor limiting white-tailed prairie dog populations and distribution in Colorado is sylvatic plague, an introduced, flea-transmitted disease caused by the bacterium *Yersinia pestis* (Seglund and Schnurr 2009). Plague is thought to be the most critical threat to sustained conservation of prairie dog species (Cully and Williams 2001; Pauli et al. 2006b).

Rangeland condition has been altered due to the introduction of non-native plant species including, but not limited to, cheatgrass. Cheatgrass is an aggressive species that can become a monoculture due to its ability to deplete soil moisture and out-compete native perennials. The proliferation of cheatgrass over native perennial grasses and forbs may impact the ability of prairie dogs to meet their dietary needs, resulting in increased mortality rates and decreased productivity (Ritchie 1999). Cheatgrass may not provide sufficient above- or below-ground forage or water stores, which white-tailed prairie dogs need to subsist. In addition, the early green-up of cheatgrass may be beneficial to prairie dogs in spring, but as it goes to seed and dries out, prairie dogs may have few options to supplement their diets. During drought conditions, vast monocultures of cheatgrass may be detrimental to prairie dog populations. This is because cheatgrass seeds will remain dormant during dry years, and thus prairie dog colonies located in cheatgrass-dominated sites will have their forage severely depleted, resulting in an inability to develop fat stores to survive over the winter or to produce litters.

11 Climate Change & Severe Weather

White-tailed prairie dogs evolved to live in arid areas that experience periodic droughts. However, human-facilitated changes in ecosystems in the west, including plant species composition, ecosystem function, and ecosystem structure (Fleischner 1994), may cause prairie dogs to be more susceptible to drought conditions. In addition, climate change may be increasing the number and duration of drought events, making it more difficult for prairie dogs to survive. Management of rangelands needs to consider the relative influence of climate change. While there are many uncertainties about how climate change will affect certain habitats, an overall management strategy that maintains a larger landscape, and thereby increases the ability

of the given species to adjust their range, should be incorporated in the overall conservation of the species.

Information Needs

Methods for managing plague on a landscape level, and at complexes and colonies important for conservation, are needed.

Conservation Actions

Continue dusting colonies to protect against plague events, continue work on the oral plague vaccine, and continue using occupancy surveys to evaluate status of the species statewide. Implement strategies from the Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy (Seglund and Schnurr 2009).

Wolverine (*Gulo gulo*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Federal listing documents (link in Appendix D).

Threats

4 Transportation & Service Corridors

Transportation corridors including interstates and secondary roads, although uncommon in wolverine habitat, are known to negatively impact wolverine movements and can cause mortality from vehicle collisions (Austin 1998; Krebs et al. 2004). Increasing road and housing development continue to fragment mountain landscapes, disrupting wolverine dispersal corridors. Preserving connectivity corridors for wolverine movement will be critical for their rangewide long-term conservation (Inman et al. 2013).

6 Human Intrusions & Disturbance

Wolverines occupy alpine environments because, among other factors, physiologically they require colder temperatures, and because they face less competition from other large mammals that are absent from these environs in the winter. The impact that winter alpine recreation has on wolverines is unknown, but such recreation is increasing and may be affecting wolverine productivity (Krebs et al. 2007). However, studies in Idaho indicate that there may not be a negative relationship at the home range scale (Heinemeyer and Squires 2013). The incidental loss of wolverines in the United States to trapping targeting other furbearers is not currently considered a threat to wolverine population viability (USFWS 2013c).

11 Climate Change & Severe Weather

Uncertainty persists around the relationship between climate change and wolverine ecology. The predicted effects of climate change in the West include a reduced snowpack and shorter periods of snow cover, snowmelt that occurs earlier in the season, a hydrologic cycle that is more dynamic as extreme rainfall events occur with greater frequency, and overall warmer, drier, and more drought-like conditions (Melillo 2014). These predicted changes could impact the wolverine given their presumed association with, and reliance on, persistent spring snow cover as a consistent component of reproductive denning habitat, and their need for low summer temperatures to maintain thermoneutrality (Copeland et al. 2010). These physiographic changes are thought to be less severe in the southern Rockies portion of the historic range of the species.

The effects of climate change on wolverine include the potential for a decrease in area of suitable habitat, increased isolation of remaining habitat, and the disruption of ability of wolverines to disperse between patches of suitable habitat (McKelvey et al. 2011). It has been postulated that Colorado may retain some of the higher quality wolverine habitat in the lower 48 states. This has been described and further examined through USFWS processes including a proposed rule to list the species, and a subsequent withdrawal of the proposed rule¹⁴.

14 Natural Factors

There is evidence that wolverines in the Rocky Mountains of the U.S. exist in small semi-isolated subpopulations without enough movement between subpopulations to maintain genetic diversity (Cegelski et al. 2006). Currently, no deleterious effects have been documented to the U.S. wolverine population from this genetic isolation, but low genetic diversity is still a concern (IDFG 2014).

Information Needs

Given that wolverines are potentially at risk due to changes in climate, a better understanding of the ecology, behavior, and physiology of wolverines with respect to temperature thresholds and dependence on snow cover and/or depth is needed (IDFG 2014). Research is also needed on wolverine distribution and abundance; natal and maternal den selection; and on how landscape scale disturbances including wildfire, insect outbreaks, timber harvest, forest seral stages, and travel corridor location impact the wolverines use of forests (IDFG 2014). Additionally, stand-level studies on wolverine habitat use are needed in order to understand if it is necessary to develop management recommendations for forest harvest prescriptions, road densities, and human footprint thresholds (IDFG 2014).

¹⁴ <https://www.fws.gov/mountain-prairie/species/mammals/wolverine>

Conservation Actions

Currently, there is not a population of wolverine in Colorado. Prior to the recent (2009) exploration of an individual male, the last confirmed wolverine sighting in Colorado was in 1919. We believe that the state had a population in the late 1800–early 1900's, but that it was extirpated in the early 1900's. Through geographical and biological analyses, it is felt that Colorado offers a substantial amount of suitable, previously occupied habitat (CPW 2010b). Preliminary discussions regarding the potential for a wolverine re-introduction to Colorado have occurred with wildlife managers, conservation partners and stakeholders. The social and political aspects of restoring a population of wolverine to the Southern Rockies have been discussed, but are not currently satisfactorily addressed. At this point in time, the primary conservation action for this species is to continue these discussions when appropriate, and then to develop the tools and social and political support necessary to undertake a restoration with the ultimate goal of re-establishing a self-sustaining population of wolverine to the state.

TIER 1 REPTILES

Colorado Checkered Whiptail (*Aspidoscelis neotesselata*)

Threats

1 Residential & Commercial Development

Expanding urban zones within the vicinity of Pueblo, Colorado, has caused the loss of suitable habitat for the Colorado checkered whiptail and resulted in its extirpation from, or greatly reduced populations in, some areas as a result (Walker et al. 1996, 1997). Within the distribution of the whiptail (Sovell 2007), continued urbanization in the vicinity of Pueblo and Cañon City, and along the Arkansas River and its tributaries, has potential to cause future loss of habitat for the whiptail.

2 Incompatible Agriculture

For other species of *Aspidoscelis*, habitat alteration and conversion to cropland, excessive grazing, chemical brush control, alteration of riparian habitat, invasion of non-native plant species and mining are threats (NMGFD 2012; BLM 2013). This species has been extirpated from, or has greatly declined in, some areas around Pueblo, Colorado, as a result of conversion of habitat to agricultural uses (Walker et al. 1996, 1997). The activities affecting other *Aspidoscelis* species also occur within the distribution of the Colorado checkered whiptail, but their impacts on this subspecies require further investigation. However, Colorado checkered whiptails can tolerate some disturbance and populations are known to exist in moderately or heavily disturbed areas, including around buildings in parks, at rural landfills, and on flats above floodplains that are dominated by kochia (*Kochia scoparia*) (Walker et al. 1996, 1997, 2012).

7 Natural System Modifications

Throughout much of its range in Colorado, the Colorado checkered whiptail is often associated with pinyon-juniper woodlands dominated by *Pinus edulis* and/or *Juniperus monosperma*, and shrublands with sagebrush (*Artimesia tridentata*), fourwing saltbush (*Atriplex canescens*) or rabbitbrush (*Ericameria nauseosa*) (Sovell 2007). Any increase in the frequency and intensity of fire in these habitats could threaten persistence of this subspecies. There are studies suggesting that *Aspidoscelis* lizards tolerate fire well (Rochester et al. 2010; Brown et al. 2014), but what impact fire has on this subspecies requires further research.

Information Needs

Further research is required on distribution of Colorado checkered whiptail populations and how they respond to landscape scale changes to habitat structure from activities including grazing, urbanization, fire, conversion of habitat to cropland, and invasion of non-native plant species. Improved understanding of how alterations to riparian habitat affect Colorado checkered whiptail population stability is also needed.

Conservation Actions

The primary conservation action needed for the Colorado checkered whiptail is research into the distribution, habitat use, and population parameters in Colorado. This information will better inform which areas are at greatest risk from habitat loss, as well as what other threats may arise for this species.

Massasauga (*Sistrurus catenatus*)

For detailed information on threats and conservation actions needed for this species, refer to the following resources: Desert Massasauga Rattlesnake (*Sistrurus catenatus edwardsii*): a technical conservation assessment (2005) (link in Appendix D).

Threats

2 Incompatible Agriculture

In Colorado, large expanses of suitable habitat within the massasauga's range have been converted to cropland, while other areas have been degraded by incompatible grazing (Mackessy 2005). Grazing can lead to changes in vegetation structure, including altered plant species composition, percent of vegetative cover, and physical habitat structure, which can cause declines in animal abundance and diversity (Bock et al. 1984). Declines in rodent and lizard populations in grazed grasslands deprive massasauga of important populations of their prey. Water withdrawal for agricultural and urban uses lowers water tables, causing temporal ponds and streams to become even more ephemeral, which can further depress prey populations (Mackessy

2005). Ultimately, such xerification might stress massasauga beyond their tolerances for dry landscapes, causing the loss of some populations (Mackessy 2005).

4 Transportation & Service Corridors

Massasauga are particularly susceptible to mortality from vehicular strikes because they use road surfaces for warming, tend to sit for long periods on road surfaces, and are active during the night (Holycross 2003). The mortality of massasauga from vehicle strikes can be a significant cause of mortality (USFWS 2012), particularly during periods of migration to (autumn) and from (spring) hibernacula. Approximately 39 percent of massasaugas encountered by researchers are road-killed individuals (Mackessy 2005).

5 Biological Resource Use

The massasauga is a venomous rattlesnake, which encourages persecution by humans. The mortality associated from direct human take can have an impact on population sizes, but because massasauga are cryptically colored, small, and somewhat secretive, human encounter rates are limited. Subsequently, the impact suffered by massasauga populations from human persecution is probably limited (Mackessy 2005).

11 Climate Change & Severe Weather

Climate change scenarios predict increasing drought and temperatures (Melillo et al. 2014) within the range of the massasauga in the West, which could accelerate xerification processes, further facilitating declines in massasauga populations (Mackessy 2005).

Other Threats

Suitable habitat within the range of the massasauga has been lost to urbanization, desertification, water diversion and depletion and proliferation of noxious weeds (Mackessy 2005).

Information Needs

Additional information on many aspects of massasauga ecology, biology, natural history and biogeography are needed, including presence/absence and relative abundance surveys; long-term monitoring of existing populations; sensitivity and threshold levels to habitat disturbance; birthing habitat requirements, mating phenology; whether foraging and hibernating habitat availability is limiting; what factors are important to successful re-establishment of recovered habitats; and population age structure and longevity.

Conservation Actions

Protection and improvement of existing and historic habitat, especially through Best Management Practices, conservation easements, and habitat restoration, will improve the outlook for massasauga in Colorado. Development of a recovery plan for massasauga will better inform the specific actions necessary for the long-term protection of individual populations through out the state.

**Table 7. Species of Greatest Conservation Need Threats and Conservation Actions
Vertebrates and Mollusks.**

Sorted by priority (Tier 1 and 2), then by Taxonomic Group, then by Common Name.

		Tier 1		Amphibians										
Boreal toad (Southern Rocky Mountain Population) <i>Anaxyrus boreas boreas</i>	Population Status and Trend	Distribution		Type	Habitat	Primary								
		Low	D Stable			D	Southern Rocky Mountains	P	Lakes	Mountain Streams	Riparian Woodlands and Shrublands	Wetlands	Aspen	Lodgepole Pine
Tier 1 Amphibians	Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.					<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority									
07.3 Other Ecosystem Modifications	Altered native vegetation (loss of riparian zone cottonwood and aspen due to encroachment of coniferous forest)	2.3 Habitat & Natural Process Restoration		Restore riparian vegetation (deciduous hardwoods)	H									
08.4 Pathogens	Pathogen - chytrid fungus	2.2 Invasive/Problematic Species Control		Follow established protocols for species research to avoid spread of pathogens	H									
08.4 Pathogens	Pathogen - chytrid fungus	3.4 Ex-situ Conservation		Create captive breeding program	H									
08.4 Pathogens	Pathogen - chytrid fungus	3.4 Ex-situ Conservation		Create gene-banking program	H									
08.4 Pathogens	Pathogen - chytrid fungus	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	H									
08.4 Pathogens	Pathogen - chytrid fungus	8.0 Research & Monitoring		Research chytrid transmission mechanisms and factors conferring chytrid resistance	H									
11.2 Droughts	Drying out of breeding habitat	8.0 Research & Monitoring		Research population parameters and/or monitor status	H									
11.3 Temperature Extremes	Alteration of breeding phenology	8.0 Research & Monitoring		Research population parameters and/or monitor status	H									
14.1 Scarcity (leading to inbreeding depression)	Low population numbers	3.3 Species Re-Introduction		Re-introduce locally extirpated native species	H									
06.1 Recreational Activities	Campsite and hiking or ORV trail development and use	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	M									
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Restore or maintain suitable hydrological regime	M									
07.3 Other Ecosystem Modifications	Altered animal community (loss of beaver)	2.3 Habitat & Natural Process Restoration		Maintain and restore natural ponds and small mountain lakes	M									
02.3 Livestock Farming & Ranching	Altered native riparian and wetland vegetation	2.1 Site/Area Management		Implement compatible grazing practices	L									
04.1 Roads & Railroads	Local impacts from roadkill	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	L									
07.2 Dams & Water Management/Use	Altered hydrological regime - siltation and sedimentation	2.3 Habitat & Natural Process Restoration		Improve excess sedimentation conditions	L									

Table 7 - Continued.

Northern leopard frog

Lithobates pipiens

Tier 1 Amphibians

Population Status and Trend	Distribution	Type	Habitat	Primary
Low X Declining X Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Central Shortgrass Prairie Colorado Plateau Front Range Southern Rocky Mountains Utah High Plateau Wyoming Basin	P p p P P P	Colorado Plateau - Wyoming Basins Rivers Colorado Plateau - Wyoming Basins Streams Eastern Plains Rivers Eastern Plains Streams Lakes Mountain Streams Riparian Woodlands and Shrublands Transition Streams Wetlands Mixed Conifer	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	H
08.1 Invasive Non-Native/Alien Species	Invasive animals - bullfrogs	2.2 Invasive/Problematic Species Control	Control bullfrogs using accepted integrated pest management techniques for aquatic habitats	H
08.4 Pathogens	Pathogen - chytrid fungus	2.2 Invasive/Problematic Species Control	Follow established protocols for species research to avoid spread of pathogens	H
08.4 Pathogens	Pathogen - chytrid fungus	8.0 Research & Monitoring	Research Bd transmission mechanisms and factors conferring Bd resistance	H
02.3 Livestock Farming & Ranching	Altered native riparian and wetland vegetation	2.1 Site/Area Management	Implement compatible grazing practices	M
04.1 Roads & Railroads	Local impacts from roadkill	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) and water management infrastructure	2.3 Habitat & Natural Process Restoration	Restore habitat and maintain suitable hydrological regime	M
09.5 Air-Borne Pollutants	Air and water pollution	2.3 Habitat & Natural Process Restoration	Identify and control point-source and non-point source pollution	M
11.2 Droughts	Drying out of breeding habitat	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
11.3 Temperature Extremes	Alteration of breeding phenology	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
03.1 Oil & Gas Drilling	Fragmentation of habitat (roads, culverts, etc.); impact on quality, impact on ground water availability; sedimentation of ponds; loss of habitat	2.1 Site/Area Management	Work with state and federal partners to limit oil/gas leasing and development	L
06.1 Recreational Activities	Potential for localized impacts (behavioral avoidance, habitat degradation) near high-use trails	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
08.1 Invasive Non-Native/Alien Species	Predaceous game fish	2.2 Invasive/Problematic Species Control	Avoid stocking predaceous game fish in occupied habitat	L
13.1 Complete distribution in Colorado unknown	Identification of occupied wetlands needed to guide conservation easement and land protection	8.0 Research & Monitoring	Conduct additional inventory for occupied wetland habitats.	L

Table 7 - Continued.

		Tier 1				Birds			
Brown-capped rosy-finch <i>Leucosticte australis</i> Tier 1 Birds	Population Status		and Trend		Distribution	Type	Habitat	Primary	
	Unknown	X	Unknown	X	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>	
							Cliffs and Canyons	<input type="checkbox"/>	
							Desert Shrub	<input type="checkbox"/>	
							Sagebrush	<input type="checkbox"/>	
							Saltbush	<input type="checkbox"/>	
						Upland Shrub	<input type="checkbox"/>		
General Threat	Specific Threat			General Conservation Action		Specific Conservation Action		Priority	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			8.0 Research & Monitoring		Conduct primary research on species and habitat responses to changing climate		H	
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring		Research population parameters and/or monitor status, including threats at both summer breeding and wintering sites.		H	
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring		Research population parameters and/or monitor status; develop and implement monitoring plan		H	
02.3 Livestock Farming & Ranching	Destruction of shrubland understory (winter habitat) due to sheep grazing			2.3 Habitat & Natural Process Restoration		Restore native habitat using site-specific techniques and context		L	
06.1 Recreational Activities	Rock climbing, hiking near cliffs and crevices			2.1 Site/Area Management		Manage public use to be compatible with biodiversity		L	
Burrowing owl <i>Athene cunicularia</i> Tier 1 Birds	Population Status		and Trend		Distribution	Type	Habitat	Primary	
	Medium	D	Stable	D	Central Shortgrass Prairie	P	Desert Shrub	<input checked="" type="checkbox"/>	
					Colorado Plateau	P	Sandsage	<input checked="" type="checkbox"/>	
					Front Range	P	Shortgrass Prairie	<input checked="" type="checkbox"/>	
					Southern Rocky Mountains	P	Mixed and Tallgrass Prairies	<input type="checkbox"/>	
					Utah High Plateau	P	Sagebrush	<input type="checkbox"/>	
						Saltbush	<input type="checkbox"/>		
General Threat	Specific Threat			General Conservation Action		Specific Conservation Action		Priority	
08.4 Pathogens	Loss of prairie dog colonies due to sylvatic plague			8.0 Research & Monitoring		Research and develop effective vaccine and delivery system for prairie dogs		H	
08.4 Pathogens	Loss of prairie dog colonies due to sylvatic plague			8.0 Research & Monitoring		Research species/habitat response to plague management		H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		M	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic		M	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.2 Policies & Regulations		Promote zoning that concentrates use and protects habitat		M	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects, urban development, landscaping, etc.		M	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			6.4 Conservation Payments		Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)		M	
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)			5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs		M	
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		M	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Loss of habitat (prairie dog colonies) due to plague and prairie dog control			3.1 Species Management		Write and implement management/recovery plan		M	
02.3 Livestock Farming & Ranching	Poisoning (indirect effect of prairie dog control)			4.3 Awareness & Communications		Implement landowner outreach/education program		L	
06.1 Recreational Activities	Recreational shooting of prairie dogs			2.1 Site/Area Management		Implement shooting closures/seasons where local conditions warrant		L	

Table 7 - Continued.

Columbian sharp-tailed grouse		Population Status and Trend		Distribution	Type	Habitat	Primary		
<i>Tympanuchus phasianellus columbianus</i> Tier 1 Birds	Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Medium	D	Stable	D	Southern Rocky Mountains	P	Conservation Reserve Program	<input checked="" type="checkbox"/>
						Wyoming Basin	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
								Sagebrush	<input checked="" type="checkbox"/>
								Agriculture	<input type="checkbox"/>
								Foothill and Mountain Grasslands	<input type="checkbox"/>
								Riparian Woodlands and Shrublands	<input type="checkbox"/>
								Upland Shrub	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore historic cropland and Conservation Reserve Program lands, including native understory species and sagebrush	H
02.1 Annual & Perennial Non-Timber Crops	Loss of compatible Conservation Reserve Program lands	5.2 Policies & Regulations	Encourage use of Farm Bill programs - optimize incentives for maintaining CRP that is compatible with habitat requirements	H
02.1 Annual & Perennial Non-Timber Crops	Poor quality Conservation Reserve Program lands	5.2 Policies & Regulations	Encourage use of Farm Bill programs - require existing CRP within species range to meet specific habitat standards; renovate poor quality fields	H
07.3 Other Ecosystem Modifications	Loss of mountain shrub and grassland habitats	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	H
07.3 Other Ecosystem Modifications	Rangewide species decline	3.3 Species Re-Introduction	Re-introduce extirpated native species; translocate species to historic range	H
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	H
08.1 Invasive Non-Native/Alien Species	Weeds on the State's A list	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	M
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	M
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.1 Site/Area Management	Employ grazing as a tool for compatible vegetation cover, structure, composition	M
02.3 Livestock Farming & Ranching	Grazing intensity on reclaimed mine lands	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
02.3 Livestock Farming & Ranching	Grazing intensity on reclaimed mine lands	5.3 Private Sector Standards & Codes	Implement Best Management Practices for livestock grazing	M
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseeding of native species, and maintenance of appropriate patch size and habitat mosaic	M
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
06.1 Recreational Activities	Motorized and non-motorized recreation, proximal non-recreation disturbance on leks	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M

Table 7 - Continued.

07.3 Other Ecosystem Modifications	Loss of mountain shrub and grassland habitats	7.3 Conservation Finance	Provide economic assistance for private land habitat improvements and/or species conservation	M
08.2 Problematic Native Species	Grazing impacts from deer and elk	3.1 Species Management	Maintain deer and elk populations within carrying capacity for healthy habitat	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

Table 7 - Continued.

Golden eagle

Aquila chrysaetos

Tier 1 Birds

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	X	Unknown	X	Central Shortgrass Prairie	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
				Colorado Plateau	P	Foothill and Mountain	<input checked="" type="checkbox"/>
				Front Range	p	Grasslands	
				Southern Rocky Mountains	p	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
				Utah High Plateau	p	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
				Utah-Wyoming Rocky Mountains	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
				Wyoming Basin	p	Sagebrush	<input checked="" type="checkbox"/>
						Shortgrass Prairie	<input checked="" type="checkbox"/>
						Alpine	<input type="checkbox"/>
						Aspen	<input type="checkbox"/>
						Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
						Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
						Conservation Reserve Program	<input type="checkbox"/>
						Desert Shrub	<input type="checkbox"/>
						Eastern Plains Rivers	<input type="checkbox"/>
						Eastern Plains Streams	<input type="checkbox"/>
						Greasewood	<input type="checkbox"/>
						Lodgepole Pine	<input type="checkbox"/>
						Mixed Conifer	<input type="checkbox"/>
						Mountain Streams	<input type="checkbox"/>
						Playas	<input type="checkbox"/>
						Ponderosa Pine	<input type="checkbox"/>
						Saltbush	<input type="checkbox"/>
						Sandsage	<input type="checkbox"/>
						Spruce - Fir	<input type="checkbox"/>
						Subalpine Limber - Bristlecone Pine	<input type="checkbox"/>
						Transition Streams	<input type="checkbox"/>
						Upland Shrub	<input type="checkbox"/>
						Wetlands	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	8.0 Research & Monitoring	Develop and prioritize standardized raptor nest monitoring with pre- and post-development data	M
03.3 Renewable Energy	Collision with wind turbines	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Mortality and prey reduction through rodent control	4.3 Awareness & Communications	Implement landowner outreach/education program	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Secondary poisoning (anticoagulants, lead shot)	5.2 Policies & Regulations	Monitor for potential impacts and respond as warranted by local conditions	M
06.1 Recreational Activities	Recreational climbing, hiking, and biking trails	2.1 Site/Area Management	Implement seasonal closures	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Table 7 - Continued.

Greater sage-grouse		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Birds	Medium D Increasing D Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>
			Utah High Plateau	P	Agriculture	<input type="checkbox"/>
			Utah-Wyoming Rocky Mountains	P	Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
			Wyoming Basin	P	Conservation Reserve Program	<input type="checkbox"/>
			Colorado Plateau	O		
General Threat		Specific Threat	General Conservation Action	Specific Conservation Action		Priority
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseedling of native species, and maintenance of appropriate patch size and habitat mosaic			H
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development			H
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining, including reduction of infrastructure and associated traffic and noise			H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection			M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic			M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat			M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.			M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)			M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseedling of native species, and maintenance of appropriate patch size and habitat mosaic			M
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.1 Site/Area Management	Employ grazing as a tool for compatible vegetation cover, structure, composition			M
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseedling of native species, and maintenance of appropriate patch size and habitat mosaic			M
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs			M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime and include treatment of pinyon-juniper to restore sagebrush habitat			M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan			M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.3 Habitat & Natural Process Restoration	Restore native understory species			M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production			M
06.1 Recreational Activities	Motorized and non-motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity (e.g., seasonal closures, managed lek viewing)			L
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness			L

Table 7 - Continued.

Greater sandhill crane		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Birds	Medium	D	Stable	D	Southern Rocky Mountains	P	Agriculture	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains	P	Wetlands	<input checked="" type="checkbox"/>
						Wyoming Basin	P	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
						Colorado Plateau	O	Foothill and Mountain Grasslands Mountain Streams	<input type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.							
General Threat		Specific Threat		General Conservation Action	Specific Conservation Action		Priority		
04.2 Utility & Service Lines		Collision with wind turbines and utility lines		5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and utility line development/placement		M		
07.2 Dams & Water Management/Use		Loss or degradation of wetland habitat		2.3 Habitat & Natural Process Restoration	Maintain wetlands in San Luis Valley that support migrating cranes		M		
07.3 Other Ecosystem Modifications		Natural system modification - wetland filling		5.4 Compliance & Enforcement	Enforce 404 wetlands regulations		M		
13.1 Complete distribution in Colorado unknown		Need improved knowledge of breeding distribution		8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		M		
02.1 Annual & Perennial Non-Timber Crops		Reduction in food resources - loss of small grain fields		3.1 Species Management	Develop collaborative management agreements		L		
02.1 Annual & Perennial Non-Timber Crops		Reduction in food resources - loss of small grain fields		5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs		L		
02.1 Annual & Perennial Non-Timber Crops		Reduction in food resources - loss of small grain fields		7.2 Alliance & Partnership Development	Develop partnerships to help maintain small grain farming in the Yampa Valley		L		
06.1 Recreational Activities		Motorized and non-motorized recreation		2.1 Site/Area Management	Manage public use to be compatible with biodiversity, including seasonal closures where necessary		L		
06.1 Recreational Activities		Motorized and non-motorized recreation		4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness		L		
14.2 Low annual recruitment		Low annual recruitment		8.0 Research & Monitoring	Research population parameters and/or monitor status		L		

Table 7 - Continued.

Gunnison sage-grouse		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Birds	Low D Stable D Rangewide population is stable, but some satellite populations have declined. Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Colorado Plateau	P	Conservation Reserve Program	<input checked="" type="checkbox"/>
			Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>
					Agriculture	<input type="checkbox"/>
General Threat		Specific Threat	General Conservation Action	Specific Conservation Action	Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation, urban development, landscaping, etc.	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore historic cropland and Conservation Reserve Program lands, including native understory species and sagebrush	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseedling of native species, and maintenance of appropriate patch size and habitat mosaic	H		
02.1 Annual & Perennial Non-Timber Crops	Loss of compatible Conservation Reserve Program lands	5.2 Policies & Regulations	Encourage use of Farm Bill programs - optimize incentives for maintaining CRP that is compatible with habitat requirements	H		
02.1 Annual & Perennial Non-Timber Crops	Poor quality Conservation Reserve Program lands	5.2 Policies & Regulations	Encourage use of Farm Bill programs - optimize incentives for maintaining CRP that is compatible with habitat requirements	H		
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.1 Site/Area Management	Employ grazing as a tool for compatible vegetation cover, structure, composition	M		
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseedling of native species, and maintenance of appropriate patch size and habitat mosaic	M		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseedling of native species, and maintenance of appropriate patch size and habitat mosaic	M		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development	M		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining, including reduction of infrastructure and associated traffic and noise	M		
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Restore sagebrush	M		

Table 7 - Continued.

06.1 Recreational Activities	Motorized and non-motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity (e.g., seasonal closures, managed lek viewing)	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime and include treatment of pinyon-juniper to restore sagebrush habitat	M
07.3 Other Ecosystem Modifications	Habitat degradation from a variety of sources	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseeding of native species, and maintenance of appropriate patch size and habitat mosaic	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.3 Habitat & Natural Process Restoration	Restore native understory species	M
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Table 7 - Continued.

Lesser prairie-chicken		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Birds	Low D Increasing D	Central Shortgrass Prairie	P	Conservation Reserve Program	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.			Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
					Sandsage	<input checked="" type="checkbox"/>
					Agriculture	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore historic cropland and Conservation Reserve Program lands, including native understory species and sagebrush	H		
02.1 Annual & Perennial Non-Timber Crops	Loss of compatible Conservation Reserve Program lands	5.2 Policies & Regulations	Encourage use of Farm Bill programs - optimize incentives for maintaining CRP that is compatible with habitat requirements	H		
02.1 Annual & Perennial Non-Timber Crops	Poor quality Conservation Reserve Program lands	5.2 Policies & Regulations	Encourage use of Farm Bill programs - require existing CRP within species range to meet specific habitat standards; renovate poor quality fields	H		
02.3 Livestock Farming & Ranching	Altered native vegetation	2.1 Site/Area Management	Implement compatible grazing practices	H		
02.3 Livestock Farming & Ranching	Altered native vegetation	8.0 Research & Monitoring	Research species/habitat response to management	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing practices	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	8.0 Research & Monitoring	Research species/habitat response to management	H		
02.3 Livestock Farming & Ranching	Reduced grass/forb diversity	8.0 Research & Monitoring	Research species/habitat response to management	H		
03.1 Oil & Gas Drilling	Behavioral avoidance of oil & gas development and associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil & gas development and associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H		
03.3 Renewable Energy	Behavioral avoidance of renewable energy development and associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H		
03.3 Renewable Energy	Fragmentation of native habitat due to renewable energy development and associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H		
03.3 Renewable Energy	Renewable energy development	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	H		
11.2 Droughts	Lack of water for habitat	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	H		
14.1 Scarcity (leading to inbreeding depression)	Small number of birds left in Colorado	3.3 Species Re-Introduction	Re-introduce extirpated native species	H		

Table 7 - Continued.

03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	M
03.3 Renewable Energy	Wind farms	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
03.3 Renewable Energy	Wind farms	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	M
08.2 Problematic Native Species	Predation and parasites	8.0 Research & Monitoring	Research impact of parasites on bird survival	M
08.2 Problematic Native Species	Predation and parasites	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
11.2 Droughts	Reduced production and survival	2.3 Habitat & Natural Process Restoration	Restore native habitats adapted to drought conditions where possible	M
11.4 Storms & Flooding	Blizzards and impact of hail and flooding on chicks and adults	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
02.3 Livestock Farming & Ranching	Egg trampling	8.0 Research & Monitoring	Research species/habitat response to management	L
04.2 Utility & Service Lines	Transport of energy & resources (e.g., electrical and phone wires, oil and gas pipelines, electrocution of wildlife)	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L
04.2 Utility & Service Lines	Transport of energy & resources (e.g., electrical and phone wires, oil and gas pipelines, electrocution of wildlife)	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	L
08.2 Problematic Native Species	Predation and parasites	3.2 Species Recovery	Reduce nest predators	L
14.4 Predation	Nest predation	3.1 Species Management	Reduce nest predators	L

Table 7 - Continued.

Mountain plover		Population Status and Trend		Distribution	Type	Habitat	Primary		
<i>Charadrius montanus</i> Tier 1 Birds	Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Low	D	Stable	D	Central Shortgrass Prairie	P	Shortgrass Prairie	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Agriculture	<input type="checkbox"/>
								Desert Shrub	<input type="checkbox"/>
								Foothill and Mountain Grasslands	<input type="checkbox"/>
								Mixed and Tallgrass Prairies	<input type="checkbox"/>
								Playas	<input type="checkbox"/>
								Saltbush	<input type="checkbox"/>
General Threat	Specific Threat			General Conservation Action		Specific Conservation Action	Priority		
08.4 Pathogens	Loss of prairie dog colonies due to sylvatic plague			8.0 Research & Monitoring		Research and develop effective vaccine and delivery system for prairie dogs	H		
08.4 Pathogens	Loss of prairie dog colonies due to sylvatic plague			8.0 Research & Monitoring		Research species/habitat response to plague management	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M		
02.1 Annual & Perennial Non-Timber Crops	Farm equipment running on fallow fields late in season (e.g. sunflower and millet fields)			5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M		
02.3 Livestock Farming & Ranching	Altered native vegetation (degradation of native shortgrass prairie)			2.1 Site/Area Management		Implement compatible grazing practices	M		
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)			5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	M		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil & gas development and associated infrastructure			5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M		
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Loss of habitat (prairie dog colonies) due to plague and prairie dog control			2.3 Habitat & Natural Process Restoration		Restore native habitat using site-specific techniques and context	M		
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Loss of habitat (prairie dog colonies) due to plague and prairie dog control			3.1 Species Management		Develop collaborative management agreements	M		
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Loss of habitat (prairie dog colonies) due to plague and prairie dog control			4.3 Awareness & Communications		Implement landowner outreach/education program	M		
07.1 Fire & Fire Suppression	Lack of fire to create bare ground			2.3 Habitat & Natural Process Restoration		Conduct controlled burns where and when appropriate to create beneficial habitat	M		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	L		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	L		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.2 Policies & Regulations		Promote zoning that concentrates use and protects habitat	L		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	L		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			6.4 Conservation Payments		Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	L		
02.1 Annual & Perennial Non-Timber Crops	Accidental nest destruction from tillage of crop fields			4.3 Awareness & Communications		Implement landowner outreach/education program	L		

Table 7 - Continued.

Plains sharp-tailed grouse		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Low	D	Stable	D	Central Shortgrass Prairie	P	Conservation Reserve Program	<input checked="" type="checkbox"/>
				Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.		Sandsage			<input checked="" type="checkbox"/>
						Mixed and Tallgrass Prairies			<input type="checkbox"/>
<i>Tympanuchus phasianellus jamesi</i>									
Tier 1 Birds									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	H				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	H				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations		Promote zoning that concentrates use and protects habitat	H				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	H				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments		Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	H				
02.1 Annual & Perennial Non-Timber Crops	Loss of compatible Conservation Reserve Program lands	5.2 Policies & Regulations		Encourage use of Farm Bill programs - optimize incentives for maintaining CRP that is compatible with habitat requirements	H				
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management		Implement compatible grazing practices	M				
03.1 Oil & Gas Drilling	Altered native vegetation	2.3 Habitat & Natural Process Restoration		Restore native habitat using site-specific techniques and context	M				
03.3 Renewable Energy	Collision with wind turbines	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M				
04.1 Roads & Railroads	Roads associated with energy development - collision and fragmentation	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	M				
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M				
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration		Restore natural fire regime	M				
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Write and/or implement integrated weed/pest management plan	M				
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring		Conduct primary research on species and habitat responses to changing climate	M				
14.1 Scarcity (leading to inbreeding depression)	Scarcity	8.0 Research & Monitoring		Research population parameters and/or monitor status	L				

Table 7 - Continued.

Southern white-tailed ptarmigan

Lagopus leucura altipetens

Tier 1 Birds

Population Status and Trend		Distribution	Type	Habitat	Primary
Medium	D Stable	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.				Riparian Woodlands and Shrublands	<input type="checkbox"/>
				Wetlands	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Continue monitoring species and habitat responses to changing climate	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Continue primary research on species and habitat responses to changing climate	H
02.3 Livestock Farming & Ranching	Degradation of alpine habitats from sheep grazing & disturbance by guard dogs	2.1 Site/Area Management	Implement compatible grazing practices	M
06.1 Recreational Activities	Hiking, destruction of willows by ATVs and snowmobiles, and roads that affect hydrological system	2.3 Habitat & Natural Process Restoration	Restore and/or close overused trails and tracks	M
08.2 Problematic Native Species	Elk grazing/browsing in alpine & subalpine willow habitat	2.3 Habitat & Natural Process Restoration	Manage natural herbivory	M
01.3 Tourism & Recreation Areas	Recreation area developments	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	L
06.1 Recreational Activities	Hiking, destruction of willows by ATVs and snowmobiles, and roads that affect hydrological system	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L

Southwestern willow flycatcher

Empidonax traillii extimus

Tier 1 Birds

Population Status and Trend		Distribution	Type	Habitat	Primary
Low	D Stable	Southern Rocky Mountains	P	Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.					

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	River flow management and riverbank protection	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
07.3 Other Ecosystem Modifications	Altered native vegetation (cottonwood/willow degradation)	2.3 Habitat & Natural Process Restoration	Remove invasive species (tamarisk, Russian olive) and restore natural willow and cottonwood riparian systems, using techniques that are sensitive to temporary impacts to flycatchers inhabiting degraded woodlands	M
12.1 Lack of coordination	Continued collaboration among stakeholders is warranted	3.1 Species Management	Implement existing management/recovery plan	M

Table 7 - Continued.

Western yellow-billed cuckoo

Coccyzus americanus occidentalis

Tier 1 Birds

Population Status and Trend	Distribution	Type	Habitat	Primary
Low D Unknown X	Colorado Plateau Colorado Plateau	P p	Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.				

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
07.2 Dams & Water Management/Use	River flow management and riverbank protection	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	M
07.3 Other Ecosystem Modifications	Altered native vegetation (cottonwood/willow degradation)	2.3 Habitat & Natural Process Restoration	Remove invasive species (tamarisk, Russian olive) and restore natural willow and cottonwood riparian systems, using techniques that are sensitive to temporary impacts to cuckoos inhabiting degraded woodlands	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk, leafy spurge	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
07.2 Dams & Water Management/Use	Dam construction	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	L
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Tier 1 Fish

Arkansas darter

Etheostoma cragini

Tier 1 Fish

Population Status and Trend	Distribution	Type	Habitat	Primary
Medium D Stable D	Central Shortgrass Prairie Front Range	P O	Eastern Plains Streams Eastern Plains Rivers Transition Streams	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.				

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - altered flow and fluctuating temperature	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - groundwater pumping and surface water diversions	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural use (irrigation)	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration	Attain adequate flows; Restore or maintain suitable hydrological regime	H
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	1.2 Resource & Habitat Protection	Maintain habitat; Acquire water rights or instream flow rights, limit water use	H
12.2 Lack of funding	Lack of funding/resource	3.1 Species Management	Implement existing management/recovery plan	H
02.3 Livestock Farming & Ranching	Wetland degradation primarily from livestock grazing	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	M
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M
14.6 Loss of species from suitable habitat	Loss of species from suitable habitat	3.3 Species Re-Introduction	Stock species into previously occupied or suitable habitat	M
02.3 Livestock Farming & Ranching	Wetland degradation primarily from livestock grazing	2.1 Site/Area Management	Implement compatible grazing practices	L

Table 7 - Continued.

Bluehead sucker		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Fish	Medium D Unknown X	Colorado Plateau	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Southern Rocky Mountains Utah High Plateau	P O	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
		General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
		07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - dewatering	2.3 Habitat & Natural Process Restoration	Adjust operation of dam	H
		08.1 Invasive Non-Native/Alien Species	Invasive animals - aquatic predators (smallmouth bass, northern pike, walleye, burbot)	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H
		08.1 Invasive Non-Native/Alien Species	Invasive animals - white sucker	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H
		07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - siltation and sedimentation	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	M
		07.2 Dams & Water Management/Use	Natural system modification (hydrological) - Altered hydrological regime (surface or aquifer) – altered flow and/or temperature regimes	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	M
		02.3 Livestock Farming & Ranching	Alteration of stream channel flows, increased sediment loads, degraded riparian habitat	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L
		04.1 Roads & Railroads	Alteration of stream channel flows, increased sediment loads, degraded riparian habitat	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L
		05.3 Logging & Wood Harvesting	Alteration of stream channel flows, increased sediment loads, degraded riparian habitat	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L
Bonytail chub		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Fish	Low D Increasing D	Colorado Plateau	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Southern Rocky Mountains Utah High Plateau Utah-Wyoming Rocky Mountains Wyoming Basin	P O O O		
		General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
		07.2 Dams & Water Management/Use	Habitat fragmentation due to water diversion structures lacking fish passage	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)	H
		07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Adjust operation of dam	H
		08.1 Invasive Non-Native/Alien Species	Invasive animals - aquatic predators (smallmouth bass, northern pike, walleye, burbot)	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H
		13.2 Critical life history/habitat components unknown	Critical life history/habitat components unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
		14.1 Scarcity (leading to inbreeding depression)	Scarcity	3.3 Species Re-Introduction	Re-introduce extirpated native species	H
		04.1 Roads & Railroads	Potential for hazardous materials spills	2.1 Site/Area Management	Coordinate efforts to prevent or minimize hazardous materials spills with existing state and federal emergency-response plans	M
		03.2 Mining & Quarrying	Potential for toxic discharges from uranium mining	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L
		09.3 Agricultural & Forestry Effluents	Pollutants from agricultural runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Table 7 - Continued.

Brassy minnow		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Fish	Low D Unknown X Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Central Shortgrass Prairie	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
			Front Range	O	Transition Streams	<input checked="" type="checkbox"/>
					Eastern Plains Rivers	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - groundwater pumping and surface water diversions	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural use (irrigation)	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration	Attain adequate flows; Restore or maintain suitable hydrological regime	H
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam, diversion, or drop structure construction or modification	2.3 Habitat & Natural Process Restoration	Remove, modify or retrofit barriers to fish migration (improve fish passage, e.g., rock ramps or fish passage structures)	H
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	1.2 Resource & Habitat Protection	Maintain habitat; Acquire water rights or instream flow rights, limit water use	H
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, monitoring)	M
02.3 Livestock Farming & Ranching	Altered hydrological regime (surface or aquifer) - siltation and sedimentation	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Colorado pikeminnow		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Fish	Medium D Declining D Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Colorado Plateau	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
			Southern Rocky Mountains	P		
			Utah High Plateau	O		
			Utah-Wyoming Rocky Mountains	O		
			Wyoming Basin	O		

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Habitat fragmentation due to water diversion structures lacking fish passage	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)	H
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Adjust operation of dam	H
08.1 Invasive Non-Native/Alien Species	Invasive animals - aquatic predators (smallmouth bass, northern pike, walleye, burbot)	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H
03.2 Mining & Quarrying	Potential for toxic discharges from uranium mining	2.1 Site/Area Management	Coordinate efforts to prevent or minimize hazardous materials spills with existing state and federal emergency-response plans	M

Table 7 - Continued.

Colorado River cutthroat trout

Oncorhynchus clarkii pleuriticus

Tier 1 Fish

Population Status and Trend	Distribution	Type	Habitat	Primary
Medium D Increasing D	Southern Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.			Mountain Streams	<input checked="" type="checkbox"/>
			Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Habitat fragmentation due to water diversion structures lacking fish passage	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)	H
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Hunting, trapping, fishing	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	M
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences)	M
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M
02.3 Livestock Farming & Ranching	Alteration of stream channel flows, increased sediment loads, degraded riparian habitat	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L
03.2 Mining & Quarrying	Heavy metal pollution	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L
04.1 Roads & Railroads	Increased sediment loads, fish barriers (culverts)	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L

Common shiner

Luxilus cornutus

Tier 1 Fish

Population Status and Trend	Distribution	Type	Habitat	Primary
Medium D Stable D	Front Range	P	Transition Streams	<input checked="" type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Central Shortgrass Prairie	O		

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - siltation and sedimentation	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M
02.3 Livestock Farming & Ranching	Altered hydrological regime (surface or aquifer) - siltation and sedimentation	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Table 7 - Continued.

Flannelmouth sucker		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Fish	Medium	D	Unknown	X	Southern Rocky Mountains	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.				Colorado Plateau	O	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
								Lakes	<input type="checkbox"/>
General Threat		Specific Threat		General Conservation Action		Specific Conservation Action		Priority	
07.2 Dams & Water Management/Use		Altered hydrological regime (surface or aquifer)		2.3 Habitat & Natural Process Restoration		Adjust operation of dam		H	
07.2 Dams & Water Management/Use		Habitat fragmentation due to water diversion structures lacking fish passage		2.3 Habitat & Natural Process Restoration		Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)		H	
07.2 Dams & Water Management/Use		Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals		2.3 Habitat & Natural Process Restoration		Restore or maintain suitable hydrological regime		H	
08.1 Invasive Non-Native/Alien Species		Invasive animals - aquatic predators (smallmouth bass, northern pike, walleye, burbot)		2.2 Invasive/Problematic Species Control		Control non-native fish using integrated pest management techniques for aquatic habitats		H	
08.3 Introduced Genetic Material		Invasive animals - white sucker		2.2 Invasive/Problematic Species Control		Control non-native fish using integrated pest management techniques for aquatic habitats		H	
02.3 Livestock Farming & Ranching		Alteration of stream channel flows, increased sediment loads, degraded riparian habitat		2.3 Habitat & Natural Process Restoration		Restore native habitat using site-specific techniques and context		L	
04.1 Roads & Railroads		Alteration of stream channel flows, increased sediment loads, degraded riparian habitat		2.3 Habitat & Natural Process Restoration		Restore native habitat using site-specific techniques and context		L	

Flathead chub		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Fish	Medium	D	Stable	D	Central Shortgrass Prairie	P	Eastern Plains Rivers	<input checked="" type="checkbox"/>
								Eastern Plains Streams	<input checked="" type="checkbox"/>
								Transition Streams	<input checked="" type="checkbox"/>
General Threat		Specific Threat		General Conservation Action		Specific Conservation Action		Priority	
07.2 Dams & Water Management/Use		Altered hydrological regime (surface or aquifer) - dam, diversion, or drop structure construction or modification		2.3 Habitat & Natural Process Restoration		Remove, modify or retrofit barriers to fish migration (improve fish passage, e.g., rock ramps or fish passage structures)		H	
07.2 Dams & Water Management/Use		Altered hydrological regime (surface or aquifer) - dewatering		2.3 Habitat & Natural Process Restoration		Attain adequate flows; Restore or maintain suitable hydrological regime		H	
03.1 Oil & Gas Drilling		Wastewater from coalbed methane production reducing water quality & altering flows		5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		M	
03.2 Mining & Quarrying		Heavy metal contamination of streams		5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		M	
11.4 Storms & Flooding		Altered flows primarily from urban runoff		5.3 Private Sector Standards & Codes		Implement Best Management Practices for storm water management to minimize extreme peak flows		M	
11.4 Storms & Flooding		Altered flows primarily from urban runoff		7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs to minimize extreme peak flows		M	
02.3 Livestock Farming & Ranching		Overgrazing leading to decreased channel depth, increased stream width & intermittency, waste altering O2 concentrations & ammonia		5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production		L	

Table 7 - Continued.

Greenback cutthroat trout		Population Status and Trend	Distribution	Type	Habitat	Primary
		Medium D Increasing D	Southern Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Front Range	O	Mountain Streams	<input checked="" type="checkbox"/>
Tier 1	Fish					
		<i>Oncorhynchus clarkii stomias</i>				
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Habitat fragmentation due to water diversion structures lacking fish passage	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)	H		
13.3 Genetic relationship with other species and/or subspecies unknown	Taxonomic & status assessments of lineages are needed	8.0 Research & Monitoring	Complete ongoing taxonomic assessments	H		
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Hunting, trapping, fishing	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	M		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences)	M		
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M		
02.3 Livestock Farming & Ranching	Alteration of stream channel flows, increased sediment loads, degraded riparian habitat	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L		
03.2 Mining & Quarrying	Heavy metal pollution, altered channel geometry, increased sedimentation	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L		
06.1 Recreational Activities	Erosion, sedimentation, loss of vegetation along heavily-used trails	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L		
Humpback chub		Population Status and Trend	Distribution	Type	Habitat	Primary
		Low D Declining D	Utah High Plateau	P	Colorado Plateau - Wyoming	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Wyoming Basin	P	Basins Rivers	
Tier 1	Fish		Utah-Wyoming Rocky Mountains	O		
		<i>Gila cypha</i>				
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Habitat fragmentation due to water diversion structures lacking fish passage	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)	H		
08.1 Invasive Non-Native/Alien Species	Invasive animals - aquatic predators (smallmouth bass, northern pike, walleye, burbot)	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H		
04.1 Roads & Railroads	Potential for hazardous materials spills from railroads	2.1 Site/Area Management	Coordinate efforts to prevent or minimize hazardous materials spills with existing state and federal emergency-response plans	M		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Adjust operation of dam	M		
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native invertebrates using integrated pest management techniques for aquatic habitats	M		
04.2 Utility & Service Lines	Potential for hazardous materials spills from oil pipelines	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L		
09.3 Agricultural & Forestry Effluents	Pollutants from agricultural runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L		

Table 7 - Continued.

Mountain sucker		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Fish	Unknown	X	Unknown	X	Southern Rocky Mountains	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains	P	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
						Wyoming Basin	P	Mountain Streams	<input type="checkbox"/>
						Colorado Plateau	O		
						Utah High Plateau	O		
				General Conservation Action	Specific Conservation Action	Priority			
07.2 Dams & Water Management/Use		Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals		2.3 Habitat & Natural Process Restoration	Adjust operation of dam	H			
08.3 Introduced Genetic Material		Invasive animals - competition, predation, and hybridization		2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M			
04.1 Roads & Railroads		Potential for hazardous materials spills		2.1 Site/Area Management	Coordinate efforts to prevent or minimize hazardous materials spills with existing state and federal emergency-response plans	L			
Northern redbelly dace		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Fish	Low	D	Stable	D	Front Range	P	Transition Streams	<input checked="" type="checkbox"/>
						Lakes			<input type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.							
				General Conservation Action	Specific Conservation Action	Priority			
01.1 Housing & Urban Areas		Urban, suburban, and ex-urban development		2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H			
07.2 Dams & Water Management/Use		Decreased water quality		5.2 Policies & Regulations	Monitor water quality standards	H			
07.2 Dams & Water Management/Use		Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals		2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	M			
13.1 Complete distribution in Colorado unknown		Complete distribution in Colorado unknown		8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M			
Orangespotted sunfish		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Fish	Medium	D	Declining	D	Central Shortgrass Prairie	P	Eastern Plains Rivers	<input checked="" type="checkbox"/>
						Front Range	O	Eastern Plains Streams	<input checked="" type="checkbox"/>
								Lakes	<input type="checkbox"/>
								Transition Streams	<input type="checkbox"/>
				General Conservation Action	Specific Conservation Action	Priority			
01.1 Housing & Urban Areas		Housing, urban, and ex-urban development		2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H			
07.2 Dams & Water Management/Use		Altered hydrological regime (surface or aquifer)		2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H			
08.1 Invasive Non-Native/Alien Species		Invasive animals		2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M			

Table 7 - Continued.

Orangethroat darter		Population Status and Trend		Distribution	Type	Habitat	Primary
	Low	D	Stable	D	Central Shortgrass Prairie	P	Eastern Plains Streams <input checked="" type="checkbox"/> Eastern Plains Rivers <input type="checkbox"/> Transition Streams <input type="checkbox"/>
<i>Etheostoma spectabile</i>							
Tier 1 Fish							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - altered flow and fluctuating water temperature	2.3 Habitat & Natural Process Restoration		Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - groundwater pumping and surface water diversions	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural use (irrigation)	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration		Attain adequate flows; Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam, diversion, or drop structure construction or modification	2.3 Habitat & Natural Process Restoration		Remove, modify or retrofit barriers to fish migration (improve fish passage, e.g., rock ramps or fish passage structures)	H		
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	1.2 Resource & Habitat Protection		Maintain habitat; Acquire water rights or instream flow rights, limit water use	H		
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control		Control non-native fish using integrated pest management techniques for aquatic habitats	M		
Plains minnow		Population Status and Trend		Distribution	Type	Habitat	Primary
	Low	D	Unknown	X	Central Shortgrass Prairie	P	Eastern Plains Rivers <input checked="" type="checkbox"/> Eastern Plains Streams <input type="checkbox"/>
<i>Hybognathus placitus</i>							
Tier 1 Fish		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.					
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration		Attain adequate flows; Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological)	2.3 Habitat & Natural Process Restoration		Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam, diversion, or drop structure construction or modification	2.3 Habitat & Natural Process Restoration		Remove, modify or retrofit barriers to fish migration (improve fish passage, e.g., rock ramps or fish passage structures)	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - Altered flow and fluctuating water temperature	2.3 Habitat & Natural Process Restoration		Restore or maintain suitable hydrological regime	M		
14.6 Loss of species from suitable habitat	Loss of species from suitable habitat	3.3 Species Re-Introduction		Stock species into previously occupied or suitable habitat	M		
02.3 Livestock Farming & Ranching	Alteration of stream channel flows, increased sediment loads, degraded riparian habitat	2.3 Habitat & Natural Process Restoration		Restore native habitat using site-specific techniques and context	L		

Table 7 - Continued.

Plains topminnow		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	D	Declining	D	Central Shortgrass Prairie	P	Eastern Plains Rivers	<input checked="" type="checkbox"/>
					Front Range	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
							Transition Streams	<input checked="" type="checkbox"/>
<i>Fundulus sciadicus</i>								
Tier 1 Fish								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority	
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - altered flow and fluctuating water temperature			2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime		H	
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - groundwater pumping and surface water diversions			5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural use (irrigation)		H	
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering			2.3 Habitat & Natural Process Restoration	Attain adequate flows; Restore or maintain suitable hydrological regime		H	
01.1 Housing & Urban Areas	Housing, urban, and ex-urban development			2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime		M	
08.1 Invasive Non-Native/Alien Species	Invasive animals			2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats		M	
02.3 Livestock Farming & Ranching	Alteration of stream channel flows, increased sediment loads, degraded riparian habitat			2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context		L	
Razorback sucker		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	D	Increasing	D	Utah High Plateau	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
					Utah-Wyoming Rocky Mountains	P		
					Colorado Plateau	O		
					Wyoming Basin	O		
<i>Xyrauchen texanus</i>								
Tier 1 Fish								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority	
07.2 Dams & Water Management/Use	Habitat fragmentation due to water diversion structures lacking fish passage			2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)		H	
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals			2.3 Habitat & Natural Process Restoration	Adjust operation of dam		H	
08.1 Invasive Non-Native/Alien Species	Invasive animals - aquatic predators (smallmouth bass, northern pike, walleye, burbot)			2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats		H	
03.2 Mining & Quarrying	Heavy metal contamination of streams			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		M	
04.1 Roads & Railroads	Potential for hazardous materials spills from railroads			2.1 Site/Area Management	Coordinate efforts to prevent or minimize hazardous materials spills with existing state and federal emergency-response plans		M	
09.3 Agricultural & Forestry Effluents	Elevated selenium concentrations			5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production		M	
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff and sources associated with resource extraction			2.3 Habitat & Natural Process Restoration	Identify and control point-source and non-point source pollution		M	
04.2 Utility & Service Lines	Potential for hazardous materials spills from oil pipelines			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		L	

Table 7 - Continued.

Rio Grande chub		Population Status and Trend	Distribution	Type	Habitat	Primary
		Medium D Stable D	Southern Rocky Mountains	P	Rio Grande Valley Rivers	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.			Rio Grande Valley Streams	<input checked="" type="checkbox"/>
<i>Gila pandora</i>					Lakes	<input type="checkbox"/>
Tier 1 Fish					Mountain Streams	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Groundwater removal from center pivot irrigation systems	8.0 Research & Monitoring	Study impact of groundwater removal on stream flow in closed basin and impacts to native fish	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H		
08.1 Invasive Non-Native/Alien Species	Invasive animals - fathead minnow, white sucker, red shiner	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H		
03.2 Mining & Quarrying	Heavy metals & cyanide contamination	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M		
02.3 Livestock Farming & Ranching	Potential for elimination of microhabitats (woody debris, overhanging vegetation, aquatic macrophytes)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L		
Rio Grande cutthroat trout		Population Status and Trend	Distribution	Type	Habitat	Primary
		Medium D Increasing D	Southern Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.			Mountain Streams	<input checked="" type="checkbox"/>
<i>Oncorhynchus clarkii virginialis</i>						
Tier 1 Fish						
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
07.3 Other Ecosystem Modifications	Altered native vegetation (streambank cover reduction) primarily from livestock grazing	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	H		
11.2 Droughts	De-watering & elevated stream temperature	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	H		
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Hunting, trapping, fishing	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	M		
07.1 Fire & Fire Suppression	Ash flows & debris from wildfire	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	M		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences)	M		
07.3 Other Ecosystem Modifications	Fragmentation	3.2 Species Recovery	Maintain genetic connection/integrity within and between populations	M		
08.1 Invasive Non-Native/Alien Species	Invasive animals - brook trout, brown trout	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M		
08.4 Pathogens	Whirling disease	8.0 Research & Monitoring	Research and/or monitor status	L		

Table 7 - Continued.

Rio Grande sucker		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Fish	Low D Increasing D	Southern Rocky Mountains	P	Mountain Streams	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.			Rio Grande Valley Rivers	<input checked="" type="checkbox"/>
					Rio Grande Valley Streams	<input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Groundwater removal from center pivot irrigation systems	8.0 Research & Monitoring	Study impact of groundwater removal on stream flow in closed basin and impacts to native fish	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - dewatering	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - sedimentation	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	H		
08.1 Invasive Non-Native/Alien Species	Invasive animals - white sucker	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H		
Roundtail chub		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Fish	Medium D Declining D	Utah High Plateau	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Utah-Wyoming Rocky Mountains	P	Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
			Colorado Plateau	O		
		Wyoming Basin	O			
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Habitat fragmentation due to water diversion structures lacking fish passage	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences, fish passages)	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Adjust operation of dam	H		
08.1 Invasive Non-Native/Alien Species	Invasive animals - aquatic predators (smallmouth bass, northern pike, walleye, burbot)	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	H		
04.1 Roads & Railroads	Potential for hazardous materials spills from railroads	2.1 Site/Area Management	Coordinate efforts to prevent or minimize hazardous materials spills with existing state and federal emergency-response plans	L		
08.4 Pathogens	Asian tapeworm (<i>Bothriocephalus acheilognathi</i>)	8.0 Research & Monitoring	Research population parameters and/or monitor status	L		

Table 7 - Continued.

Southern redbelly dace		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1 Fish	Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Low D Declining D	Central Shortgrass Prairie	P	Transition Streams	<input checked="" type="checkbox"/>
					Eastern Plains Streams	<input type="checkbox"/>
					Lakes	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - altered flow and fluctuating water temperature	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - groundwater pumping and surface water diversions	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural use (irrigation)	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - siltation and sedimentation	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions; restore proper stream hydromorphology	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration	Attain adequate flows; Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Decreased water quality	5.2 Policies & Regulations	Monitor water quality standards	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	H		
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	1.2 Resource & Habitat Protection	Maintain habitat; Acquire water rights or instream flow rights, limit water use	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	M		
14.6 Loss of species from suitable habitat	Loss of species from suitable habitat	3.3 Species Re-Introduction	Stock species into previously occupied or suitable habitat	M		
02.3 Livestock Farming & Ranching	Wetland degradation primarily from livestock grazing	2.1 Site/Area Management	Implement compatible grazing practices	L		
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Identify and control point-source and non-point source pollution	L		
<hr/>						
Stonecat		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1 Fish		Low D Unknown X	Central Shortgrass Prairie	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
			Front Range	P	Transition Streams	<input checked="" type="checkbox"/>
					Eastern Plains Rivers	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - altered flow and fluctuating water temperature	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - groundwater pumping and surface water diversions	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural use (irrigation)	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - siltation	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration	Attain adequate flows; Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	H		
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, monitoring)	M		

Table 7 - Continued.

Suckermouth minnow		Population Status and Trend	Distribution	Type	Habitat	Primary	
Tier 1	Fish	Low	D Unknown	X	Central Shortgrass Prairie	P	Eastern Plains Rivers <input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.				Eastern Plains Streams	<input checked="" type="checkbox"/>
						Transition Streams	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - dewatering	2.3 Habitat & Natural Process Restoration		Attain adequate flows; Restore or maintain suitable hydrological regime	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - siltation and sedimentation	2.3 Habitat & Natural Process Restoration		Improve erosion and excess sedimentation conditions; restore proper stream hydromorphology	H		
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam, diversion, or drop structure construction or modification	2.3 Habitat & Natural Process Restoration		Remove, modify or retrofit barriers to fish migration (improve fish passage, e.g., rock ramps or fish passage structures)	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural use	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, monitoring)	M		
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research critical life history/habitat components	M		
14.6 Loss of species from suitable habitat	Loss of species from suitable habitat	3.3 Species Re-Introduction		Re-introduce species in suitable habitat	M		

Tier 1 Mammals

American pika		Population Status and Trend	Distribution	Type	Habitat	Primary	
Tier 1	Mammals	Medium	X Stable	D	Southern Rocky Mountains	P	Alpine <input checked="" type="checkbox"/>
						Aspen	<input type="checkbox"/>
						Lodgepole Pine	<input type="checkbox"/>
						Mixed Conifer	<input type="checkbox"/>
						Spruce - Fir	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Habitat shifting & alteration due to climate change	8.0 Research & Monitoring		Continue monitoring species and habitat responses to changing climate	H		
11.3 Temperature Extremes	Temperature extremes and precipitation changes	8.0 Research & Monitoring		Continue monitoring species and habitat responses to changing climate	H		
06.1 Recreational Activities	Hiking, ORVs, and domestic animals	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

Table 7 - Continued.

Black-footed ferret		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Mammals	Low D Unknown X Status of released ferrets is unknown. Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Central Shortgrass Prairie	P	Shortgrass Prairie	<input checked="" type="checkbox"/>
			Wyoming Basin	P	Desert Shrub	<input type="checkbox"/>
					Foothill and Mountain Grasslands	<input type="checkbox"/>
					Mixed and Tallgrass Prairies	<input type="checkbox"/>
					Sagebrush	<input type="checkbox"/>
General Threat		Specific Threat	General Conservation Action	Specific Conservation Action	Priority	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Loss of habitat (prairie dog colonies) due to plague and prairie dog control	3.1 Species Management	Work with partner agencies, NGOs and private landowners to develop incentives and agreements for conservation benefit	H	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Mortality and prey reduction through rodent control	5.2 Policies & Regulations	Continue implementing existing regulations at re-introduction sites	H	
08.4 Pathogens		Pathogen - sylvatic plague	3.1 Species Management	Develop and implement an active disease management program	H	
08.4 Pathogens		Pathogen - sylvatic plague	8.0 Research & Monitoring	Research and develop effective vaccine and delivery system	H	
13.4 Population status unknown		Lack of data on population status of released ferrets	8.0 Research & Monitoring	Research population parameters and/or monitor status	H	
14.1 Scarcity (leading to inbreeding depression)		Scarcity	3.3 Species Re-Introduction	Re-introduce extirpated native species	H	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Loss of habitat (prairie dog colonies) due to plague and prairie dog control	2.3 Habitat & Natural Process Restoration	Manage for predator/prey balance	M	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Loss of habitat (prairie dog colonies) due to plague and prairie dog control	4.3 Awareness & Communications	Implement landowner outreach/education and incentive programs	M	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Loss of habitat (prairie dog colonies) due to plague and prairie dog control	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Loss of habitat (prairie dog colonies) due to plague and prairie dog control	6.4 Conservation Payments	Implement the NRCS Black-footed Ferret Initiative program	M	
08.4 Pathogens		Pathogen - sylvatic plague	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M	
12.1 Lack of coordination		Lack of coordination	3.1 Species Management	Implement existing management/recovery plan	M	

Table 7 - Continued.

Fringed myotis		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Mammals	Unknown	D	Unknown	X	Colorado Plateau	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
						Front Range	P	Mixed Conifer	<input checked="" type="checkbox"/>
						Wyoming Basin	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
						Central Shortgrass Prairie	O	Pinyon - Juniper	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	O	Ponderosa Pine	<input checked="" type="checkbox"/>
								Aspen	<input type="checkbox"/>
								Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
								Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
								Desert Shrub	<input type="checkbox"/>
								Foothill and Mountain Grasslands	<input type="checkbox"/>
								Lodgepole Pine	<input type="checkbox"/>
								Mountain Streams	<input type="checkbox"/>
								Sagebrush	<input type="checkbox"/>
								Spruce - Fir	<input type="checkbox"/>
								Transition Streams	<input type="checkbox"/>
		Upland Shrub	<input type="checkbox"/>						
General Threat		Specific Threat		General Conservation Action	Specific Conservation Action		Priority		
06.3 Work & Other Activities		Proximal non-recreation disturbance		2.1 Site/Area Management	Manage to limit disturbance, especially to roost sites, maternity colonies, and hibernacula		H		
13.1 Complete distribution in Colorado unknown		Complete distribution in Colorado unknown		8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		H		
13.4 Population status unknown		Lack of data on population status		8.0 Research & Monitoring	Research population parameters and/or monitor status		H		
03.2 Mining & Quarrying		Uranium mining		5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		M		
07.3 Other Ecosystem Modifications		Cave/mine closures and grating		2.3 Habitat & Natural Process Restoration	Employ appropriate site-specific and/or species-specific techniques for closures and safety enhancements		M		
08.4 Pathogens		Potential for White-nose Syndrome		2.2 Invasive/Problematic Species Control	Manage recreation, research, management, and other human disturbances to control the spread of pathogens		M		
09.3 Agricultural & Forestry Effluents		Prey reduction from herbicide/pesticide spraying or runoff		2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use		L		

Table 7 - Continued.

Gunnison's prairie dog		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 1	Mammals	Medium	D	Stable	D	Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
								Sagebrush	<input checked="" type="checkbox"/>
								Greasewood	<input type="checkbox"/>
								Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
								Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining as per Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy for Oil and Gas	H
08.4 Pathogens	Pathogen - sylvatic plague	3.1 Species Management	Develop and implement an active disease management program	H
08.4 Pathogens	Pathogen - sylvatic plague	8.0 Research & Monitoring	Research and develop effective vaccine and delivery system	H
08.4 Pathogens	Pathogen - sylvatic plague	8.0 Research & Monitoring	Research species/habitat response to plague management	H
07.3 Other Ecosystem Modifications	Loss and degradation of habitat	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
07.3 Other Ecosystem Modifications	Loss and degradation of habitat	1.2 Resource & Habitat Protection	Maintain healthy colonies on public lands and on private land with large acreage	M
07.3 Other Ecosystem Modifications	Loss and degradation of habitat	2.3 Habitat & Natural Process Restoration	Restore native habitat and wet areas (controlled burning, weed control)	M
11.2 Droughts	Potential for increasing number and duration of drought events	2.3 Habitat & Natural Process Restoration	Maintain landscape connectivity to allow for species movement	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Poisoning	4.3 Awareness & Communications	Implement landowner outreach/education program	L
06.1 Recreational Activities	Recreational shooting of prairie dogs	2.1 Site/Area Management	Implement shooting closures/seasons where local conditions warrant	L

Table 7 - Continued.

Little brown myotis

Myotis lucifugus

Tier 1 Mammals

Population Status and Trend		Distribution	Type	Habitat	Primary
Unknown	X	Colorado Plateau	P	Mixed Conifer	<input checked="" type="checkbox"/>
		Southern Rocky Mountains	P	Ponderosa Pine	<input checked="" type="checkbox"/>
		Central Shortgrass Prairie	O	Aspen	<input type="checkbox"/>
				Cliffs and Canyons	<input type="checkbox"/>
				Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
				Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
				Desert Shrub	<input type="checkbox"/>
				Eastern Plains Rivers	<input type="checkbox"/>
				Eastern Plains Streams	<input type="checkbox"/>
				Foothill and Mountain Grasslands	<input type="checkbox"/>
				Lodgepole Pine	<input type="checkbox"/>
				Mountain Streams	<input type="checkbox"/>
				Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
				Pinyon - Juniper	<input type="checkbox"/>
				Riparian Woodlands and Shrublands	<input type="checkbox"/>
				Sagebrush	<input type="checkbox"/>
				Transition Streams	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Proximal non-recreation disturbance	2.1 Site/Area Management	Manage to limit disturbance, especially to roost sites, maternity colonies, and hibernacula	H
08.4 Pathogens	Potential for White-nose Syndrome	2.2 Invasive/Problematic Species Control	Manage recreation, research, management, and other human disturbances to control the spread of pathogens	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status; conduct surveillance for potential arrival of white-nose syndrome	H
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Exterminations/evictions in urban settings	2.3 Habitat & Natural Process Restoration	Develop alternative roost sites	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Exterminations/evictions in urban settings	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Exterminations/evictions in urban settings	5.2 Policies & Regulations	Provide incentives for homeowners to increase tolerance of bats	M
09.3 Agricultural & Forestry Effluents	Prey reduction from herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	L

Table 7 - Continued.

Lynx		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Mammals	Medium X Unknown X	Southern Rocky Mountains	P	Lodgepole Pine	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.			Mixed Conifer	<input checked="" type="checkbox"/>
					Spruce - Fir	<input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
12.3 Lack of common goals	Lack of Recovery Plan	3.1 Species Management	Write and implement management/recovery plan	H		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H		
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences)	M		
05.3 Logging & Wood Harvesting	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain habitat connectivity so that natural movement between occupied and unoccupied habitat can be maintained to support a naturally expanding population	M		
06.1 Recreational Activities	Unregulated backcountry winter recreation	8.0 Research & Monitoring	Research species/habitat response to management	M		
11.1 Habitat Shifting & Alteration	Habitat shifting due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M		
11.1 Habitat Shifting & Alteration	Loss of snow	2.3 Habitat & Natural Process Restoration	Maintain connectivity and improve resilience	M		
New Mexico jumping mouse		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Mammals	Low X Unknown X	Central Shortgrass Prairie Colorado Plateau Southern Rocky Mountains	O	Eastern Plains Streams	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.			Mountain Streams	<input checked="" type="checkbox"/>
					Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
					Eastern Plains Rivers	<input type="checkbox"/>
					Transition Streams	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H		
13.2 Critical life history/habitat components unknown	Biology, ecology, and habitat poorly known	8.0 Research & Monitoring	Research critical life history/habitat components	H		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H		
07.1 Fire & Fire Suppression	Wildfires exacerbated by climate change	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M		
07.2 Dams & Water Management/Use	Scouring floods	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	M		
07.3 Other Ecosystem Modifications	Altered native vegetation (streambank cover reduction)	2.3 Habitat & Natural Process Restoration	Restore riparian vegetation	M		
12.1 Lack of coordination	Lack of management/recovery plan	3.1 Species Management	Write and implement management/recovery plan	M		
12.1 Lack of coordination	Lack of management/recovery plan	7.2 Alliance & Partnership Development	Coordinate with related agencies to align goals, policies, measures of success, etc.	M		
12.2 Lack of funding	Lack of dedicated funding source	7.2 Alliance & Partnership Development	Coordinate with related agencies to identify and secure funding	M		
14.1 Scarcity (leading to inbreeding depression)	Scarcity	3.2 Species Recovery	Maintain genetic connection/integrity within and between populations	M		

Table 7 - Continued.

		Population Status and Trend		Distribution	Type	Habitat	Primary
		Unknown	X				
Olive-backed pocket mouse		Unknown	X	Central Shortgrass Prairie	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
<i>Perognathus fasciatus</i>				Utah-Wyoming Rocky Mountains	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
Tier 1	Mammals			Wyoming Basin	P	Shortgrass Prairie	<input checked="" type="checkbox"/>
				Front Range	O		
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H	
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring	Develop and implement monitoring plan	H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M	
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M	
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M	
Prebles meadow jumping mouse		Population Status and Trend		Distribution	Type	Habitat	Primary
		Low	D	Front Range	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
<i>Zapus hudsonius preblei</i>		Declining D		Central Shortgrass Prairie	O	Mountain Streams	<input checked="" type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.				Southern Rocky Mountains	O	Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
Tier 1	Mammals					Transition Streams	<input checked="" type="checkbox"/>
						Eastern Plains Rivers	<input type="checkbox"/>
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	H	
07.2 Dams & Water Management/Use	Habitat degradation from alteration of flows			2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements, restore riparian vegetation and hydrological regime	H	
12.1 Lack of coordination	Lack of USFWS conservation plan			3.1 Species Management	Write and implement management/recovery plan	H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	M	
12.1 Lack of coordination	Lack of USFWS conservation plan			7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
12.3 Lack of common goals	Lack of USFWS conservation plan			7.2 Alliance & Partnership Development	Coordinate with related agencies to align goals, policies, measures of success, etc.	M	
14.1 Scarcity (leading to inbreeding depression)	Scarcity			3.2 Species Recovery	Maintain genetic connection/integrity within and between populations	M	
07.3 Other Ecosystem Modifications	Altered animal community - change in predator/prey balance (domestic cat & bullfrog predation)			2.3 Habitat & Natural Process Restoration	Manage for predator/prey balance	L	

Table 7 - Continued.

Spotted bat

		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 1	Mammals	Low D Stable D	Utah-Wyoming Rocky Mountains	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Wyoming Basin	P	Aspen	<input type="checkbox"/>
					Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
					Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
					Desert Shrub	<input type="checkbox"/>
					Mixed Conifer	<input type="checkbox"/>
					Pinyon - Juniper	<input type="checkbox"/>
					Ponderosa Pine	<input type="checkbox"/>
Upland Shrub	<input type="checkbox"/>					

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown; information on winter distribution is needed	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
14.1 Scarcity (leading to inbreeding depression)	Scarcity	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
13.2 Critical life history/habitat components unknown	Biology, ecology, and habitat poorly known	8.0 Research & Monitoring	Research critical life history/habitat components	M
09.3 Agricultural & Forestry Effluents	Prey reduction from herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	L

Table 7 - Continued.

Townsend's big-eared bat ssp.

Corynorhinus townsendii pallescens

Tier 1 Mammals

Population Status and Trend	Distribution	Type	Habitat	Primary
Low D Unknown X	Colorado Plateau	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.	Front Range	P	Mixed Conifer	<input checked="" type="checkbox"/>
	Southern Rocky Mountains	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
	Utah High Plateau	P	Ponderosa Pine	<input checked="" type="checkbox"/>
	Utah-Wyoming Rocky Mountains	P	Aspen	<input type="checkbox"/>
	Wyoming Basin	O	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
			Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
			Desert Shrub	<input type="checkbox"/>
			Foothill and Mountain Grasslands	<input type="checkbox"/>
			Mountain Streams	<input type="checkbox"/>
			Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
			Sagebrush	<input type="checkbox"/>
			Spruce - Fir	<input type="checkbox"/>
			Transition Streams	<input type="checkbox"/>
			Upland Shrub	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.2 Mining & Quarrying	Uranium mining	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
06.1 Recreational Activities	Recreational caving	2.1 Site/Area Management	Manage to limit disturbance, especially to roost sites, maternity colonies, and hibernacula	H
06.3 Work & Other Activities	Proximal non-recreation disturbance	2.1 Site/Area Management	Manage to limit disturbance, especially to roost sites, maternity colonies, and hibernacula	H
07.3 Other Ecosystem Modifications	Cave/mine closures and grating	2.3 Habitat & Natural Process Restoration	Employ appropriate site-specific and/or species-specific techniques for closures and safety enhancements	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
08.4 Pathogens	Potential for White-nose Syndrome	2.2 Invasive/Problematic Species Control	Manage recreation, research, management, and other human disturbances to control the spread of pathogens	M
13.2 Critical life history/habitat components unknown	Biology, ecology, and habitat poorly known	8.0 Research & Monitoring	Research critical life history/habitat components	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	L
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	L
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	L
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	L
09.3 Agricultural & Forestry Effluents	Prey reduction from herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	L

Table 7 - Continued.

White-tailed prairie dog		Population Status and Trend		Distribution	Type	Habitat	Primary
<i>Cynomys leucurus</i> Tier 1 Mammals		Medium	D Stable	Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
			D	Utah-Wyoming Rocky Mountains	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
				Wyoming Basin	P	Sagebrush	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	O		
				Utah High Plateau	O		
	Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.						
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
08.4 Pathogens	Pathogen - sylvatic plague			3.1 Species Management	Develop and implement an active disease management program		H
08.4 Pathogens	Pathogen - sylvatic plague			8.0 Research & Monitoring	Research and develop effective vaccine and delivery system		H
08.4 Pathogens	Pathogen - sylvatic plague			8.0 Research & Monitoring	Research species/habitat response to plague management		H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			1.2 Resource & Habitat Protection	Maintain healthy colonies on public lands and on private land with large acreage		M
02.3 Livestock Farming & Ranching	Historic grazing with incompatible timing, intensity, duration			2.3 Habitat & Natural Process Restoration	Restore native habitat and wet areas (controlled burning, weed control)		M
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining as per Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy for Oil and Gas		M
07.1 Fire & Fire Suppression	Altered fire regime (changes in fire frequency) and pinyon-juniper encroachment			2.3 Habitat & Natural Process Restoration	Restore native habitat and wet areas (controlled burning, weed control)		M
07.3 Other Ecosystem Modifications	Loss and degradation of habitat			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		M
07.3 Other Ecosystem Modifications	Loss and degradation of habitat			1.2 Resource & Habitat Protection	Maintain healthy colonies on public lands and on private land with large acreage		M
07.3 Other Ecosystem Modifications	Loss and degradation of habitat			2.3 Habitat & Natural Process Restoration	Restore native habitat and wet areas (controlled burning, weed control)		M
08.1 Invasive Non-Native/Alien Species	Non-native plants - cheatgrass			2.3 Habitat & Natural Process Restoration	Restore native habitat and wet areas (controlled burning, weed control)		M
11.2 Droughts	Potential for increasing number and duration of drought events			2.3 Habitat & Natural Process Restoration	Maintain landscape connectivity to allow for species movement		M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		L
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Poisoning			4.3 Awareness & Communications	Implement landowner outreach/education program		L
06.1 Recreational Activities	Recreational shooting of prairie dogs			2.1 Site/Area Management	Implement shooting closures/seasons where local conditions warrant		L

Table 7 - Continued.

Wolverine		Population Status and Trend		Distribution	Type	Habitat	Primary	
Tier 1	Mammals	Unknown	X	Unknown	X	Southern Rocky Mountains	P	Alpine <input checked="" type="checkbox"/>
		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.						Aspen <input type="checkbox"/>
								Lodgepole Pine <input type="checkbox"/>
								Mixed Conifer <input type="checkbox"/>
								Subalpine Limber - Bristlecone Pine <input type="checkbox"/>
General Threat		Specific Threat		General Conservation Action	Specific Conservation Action		Priority	
12.5 Legislation/policy changes		No tools to grant public assurances for support of re-introduction		5.2 Policies & Regulations	Develop robust tool/policy to grant assurances		H	
14.1 Scarcity (leading to inbreeding depression)		Scarcity		3.3 Species Re-Introduction	Initiate roundtable discussions and develop a timeline		H	
14.1 Scarcity (leading to inbreeding depression)		Scarcity		3.3 Species Re-Introduction	Re-introduce extirpated native species		H	
11.1 Habitat Shifting & Alteration		Habitat shifting due to climate change		8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate		M	
11.1 Habitat Shifting & Alteration		Loss of snow		2.3 Habitat & Natural Process Restoration	Maintain connectivity and improve resilience		M	
13.4 Population status unknown		Lack of data on population status		8.0 Research & Monitoring	Research population parameters and/or monitor status		M	
04.1 Roads & Railroads		Fragmentation		2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic		L	
13.1 Complete distribution in Colorado unknown		Complete distribution in Colorado unknown		8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		L	

Table 7 - Continued.

		Tier 1				Reptiles			
Colorado checked whiptail	Population Status and Trend				Distribution	Type	Habitat	Primary	
	Medium	X	Stable	X					
<i>Aspidoscelis neotesselata</i>					Central Shortgrass Prairie	P	Cliffs and Canyons	<input checked="" type="checkbox"/>	
							Greasewood	<input checked="" type="checkbox"/>	
							Playas	<input checked="" type="checkbox"/>	
Tier 1	Reptiles						Conservation Reserve Program	<input type="checkbox"/>	
							Shortgrass Prairie	<input type="checkbox"/>	
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H				
13.2 Critical life history/habitat components unknown	Biology, ecology, and habitat poorly known	8.0 Research & Monitoring		Research critical life history/habitat components	H				
13.3 Genetic relationship with other species and/or subspecies unknown	Genetic relationship with other subspecies unknown	8.0 Research & Monitoring		Research genetic relation to other (sub)species	H				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations		Promote consideration of biodiversity issues in transportation and land use planning processes	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments		Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M				
12.1 Lack of coordination	Lack of conservation plan	3.1 Species Management		Develop proactive conservation program to prevent species from becoming a concern in the future	M				
12.1 Lack of coordination	Lack of management plan	3.1 Species Management		Write and implement management/recovery plan	M				

Table 7 - Continued.

Massasauga		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Medium	D Stable	D	Central Shortgrass Prairie	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
							Shortgrass Prairie	<input checked="" type="checkbox"/>
							Conservation Reserve Program	<input type="checkbox"/>
<i>Sistrurus catenatus</i>		Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.						
Tier 1	Reptiles							

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
04.1 Roads & Railroads	Collision (e.g., auto)	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M
12.1 Lack of coordination	Lack of conservation effort coordination	3.1 Species Management	Write and implement management/recovery plan	M
12.3 Lack of common goals	Lack of common conservation goals	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
04.1 Roads & Railroads	Collision (e.g., auto)	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	L
13.2 Critical life history/habitat components unknown	Biology, ecology, and habitat poorly known	8.0 Research & Monitoring	Research critical life history/habitat components	L

Tier 2 Amphibians

Blanchard's cricket frog		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Low	D Declining	D	Central Shortgrass Prairie	P	Eastern Plains Rivers	<input checked="" type="checkbox"/>
							Eastern Plains Streams	<input checked="" type="checkbox"/>
							Wetlands	<input type="checkbox"/>
<i>Acris crepitans</i>		Possibly extirpated in CO (edge of range)						
Tier 2	Amphibians							

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution unknown	8.0 Research & Monitoring	Develop and implement monitoring plan	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	L
08.1 Invasive Non-Native/Alien Species	Invasive animals - bullfrogs	2.2 Invasive/Problematic Species Control	Control bullfrogs using accepted integrated pest management techniques for aquatic habitats	L
11.1 Habitat Shifting & Alteration	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	L

Table 7 - Continued.

Canyon tree frog		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Unknown	X	Central Shortgrass Prairie	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
<i>Hyla arenicolor</i>						Colorado Plateau	P		
Tier 2	Amphibians					Southern Rocky Mountains	O	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
						Cliffs and Canyons			<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status; develop and implement monitoring plan	H				
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M				
11.1 Habitat Shifting & Alteration	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	8.0 Research & Monitoring		Conduct primary research on species and habitat responses to changing climate	M				
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M				
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	M				
08.1 Invasive Non-Native/Alien Species	Invasive animals - bullfrogs	2.2 Invasive/Problematic Species Control		Control bullfrogs using accepted integrated pest management techniques for aquatic habitats	L				
Couch's spadefoot		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Medium	X	Stable	X	Central Shortgrass Prairie	P	Shortgrass Prairie	<input checked="" type="checkbox"/>
<i>Scaphiopus couchii</i>						Wetlands			<input checked="" type="checkbox"/>
Tier 2	Amphibians								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing); develop and implement monitoring plan	H				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M				
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - threat is not well understood	8.0 Research & Monitoring		Research species/habitat response to management	M				
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	8.0 Research & Monitoring		Conduct primary research on species and habitat responses to changing climate	L				

Table 7 - Continued.

Great Basin spadefoot		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	Unknown	Colorado Plateau		Desert Shrub	<input checked="" type="checkbox"/>		
				Utah High Plateau		Pinyon - Juniper	<input checked="" type="checkbox"/>		
				Utah-Wyoming Rocky Mountains		Sagebrush	<input checked="" type="checkbox"/>		
				Wyoming Basin					
<i>Spea intermontana</i>									
Tier 2	Amphibians								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status; develop and implement monitoring plan	H				
03.1 Oil & Gas Drilling	Fragmentation of habitat (roads, culverts, etc.); impact on quality, impact on ground water availability; sedimentation of ponds; loss of habitat	2.1 Site/Area Management		Work with state and federal partners to limit oil/gas leasing and development	M				
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	M				
11.1 Habitat Shifting & Alteration	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	8.0 Research & Monitoring		Conduct primary research on species and habitat responses to changing climate	L				
Great Plains narrowmouth toad		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Unknown	X	Central Shortgrass Prairie	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
						Wetlands		<input checked="" type="checkbox"/>	
<i>Gastrophryne olivacea</i>									
Tier 2	Amphibians								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status; develop and implement monitoring plan	H				
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	L				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	L				
09.3 Agricultural & Forestry Effluents	Pesticide runoff	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	L				
11.1 Habitat Shifting & Alteration	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	8.0 Research & Monitoring		Conduct primary research on species and habitat responses to changing climate	L				
Green toad		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Unknown	X	Central Shortgrass Prairie	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
						Shortgrass Prairie		<input type="checkbox"/>	
<i>Anaxyrus debilis</i>									
Tier 2	Amphibians								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status; develop and implement monitoring plan	H				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M				
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M				
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	M				

Table 7 - Continued.

Plains leopard frog		Population Status and Trend		Distribution	Type	Habitat	Primary
	Medium	X	Declining	X	Central Shortgrass Prairie	P	Eastern Plains Rivers <input checked="" type="checkbox"/>
							Eastern Plains Streams <input checked="" type="checkbox"/>
							Riparian Woodlands and Shrublands <input checked="" type="checkbox"/>
							Wetlands <input checked="" type="checkbox"/>

Lithobates blairi

Tier 2 Amphibians

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.6 Response to change, disturbance, & other threats poorly understood	Lack of monitoring plan	8.0 Research & Monitoring	Develop and implement monitoring plan	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - threat is not well understood	8.0 Research & Monitoring	Research species/habitat response to management	M
08.1 Invasive Non-Native/Alien Species	Invasive animals - bullfrogs	2.2 Invasive/Problematic Species Control	Control bullfrogs using accepted integrated pest management techniques for aquatic habitats	M
09.3 Agricultural & Forestry Effluents	Water pollution	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Wood frog

		Population Status and Trend		Distribution	Type	Habitat	Primary
	Medium	D	Stable	D	Southern Rocky Mountains	P	Lakes <input checked="" type="checkbox"/>
							Mountain Streams <input checked="" type="checkbox"/>
							Riparian Woodlands and Shrublands <input checked="" type="checkbox"/>
							Wetlands <input checked="" type="checkbox"/>
							Aspen <input type="checkbox"/>
							Lodgepole Pine <input type="checkbox"/>
							Mixed Conifer <input type="checkbox"/>
							Spruce - Fir <input type="checkbox"/>

Lithobates sylvatica

Tier 2 Amphibians

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.6 Response to change, disturbance, & other threats poorly understood	Lack of monitoring plan	8.0 Research & Monitoring	Develop and implement monitoring plan	H
02.3 Livestock Farming & Ranching	Incompatible grazing	2.1 Site/Area Management	Implement compatible grazing practices	M
05.3 Logging & Wood Harvesting		2.1 Site/Area Management	Implement compatible forest management practices	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	L

Table 7 - Continued.

American white pelican		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Low	D	Stable	D	Central Shortgrass Prairie	P	Reservoirs and Shorelines	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
								Eastern Plains Rivers	<input type="checkbox"/>
<i>Pelecanus erythrorhynchos</i>									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M				
07.2 Dams & Water Management/Use	Altered hydrological regime (fluctuating water levels)	3.1 Species Management		Develop collaborative management agreements	M				
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M				
14.4 Predation	Nest predation	8.0 Research & Monitoring		Research population parameters and/or monitor status	L				

Bald eagle		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Low	D	Increasing	D	Central Shortgrass Prairie	P	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
						Colorado Plateau	p	Eastern Plains Rivers	<input checked="" type="checkbox"/>
						Front Range	p	Eastern Plains Streams	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	p	Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
						Utah High Plateau	p	Transition Streams	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains	P	Agriculture	<input type="checkbox"/>
						Wyoming Basin	p	Foothill and Mountain Grasslands	<input type="checkbox"/>
								Mixed and Tallgrass Prairies	<input type="checkbox"/>
		Mountain Streams	<input type="checkbox"/>						
		Playas	<input type="checkbox"/>						
		Shortgrass Prairie	<input type="checkbox"/>						
		Wetlands	<input type="checkbox"/>						
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M				
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M				
03.3 Renewable Energy	Collision with wind turbines	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M				
06.1 Recreational Activities	Motorized and non-motorized recreation	1.2 Resource & Habitat Protection		Establish exclusionary/boundary fencing, formal wildlife viewing stations/areas, signage to raise public awareness, seasonal closures	M				
06.1 Recreational Activities	Motorized and non-motorized recreation	2.1 Site/Area Management		Coordinate on ecologically sensitive design of recreational facilities	M				
06.3 Work & Other Activities	Flight paths, proximal non-recreation disturbance	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M				
07.3 Other Ecosystem Modifications	Altered native vegetation (loss of shoreline nesting, roosting, and perching habitat)	2.3 Habitat & Natural Process Restoration		Plant native trees/shrubs	L				
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	L				

Table 7 - Continued.

Band-tailed pigeon		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Low	D					Unknown	X
<i>Patagioenas fasciata</i> Tier 2 Birds				Front Range	P	Mixed Conifer	<input checked="" type="checkbox"/>		
				Southern Rocky Mountains	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>		
						Colorado Plateau		Pinyon - Juniper	<input checked="" type="checkbox"/>
						Utah High Plateau		Ponderosa Pine	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains		Agriculture	<input type="checkbox"/>
						Wyoming Basin		Aspen	<input type="checkbox"/>
								Lodgepole Pine	<input type="checkbox"/>
								Spruce - Fir	<input type="checkbox"/>
								Subalpine Limber - Bristlecone Pine	<input type="checkbox"/>
								Upland Shrub	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.1 Annual & Perennial Non-Timber Crops	Conversion of grain crops to alfalfa	7.2 Alliance & Partnership Development	Develop partnerships to help maintain small grain farming	M
07.3 Other Ecosystem Modifications	Habitat degradation	2.3 Habitat & Natural Process Restoration	Restore native habitat (mountain shrublands)	M
05.3 Logging & Wood Harvesting	Forest and woodland management	2.1 Site/Area Management	Implement compatible forest management practices	L
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Barrow's goldeneye		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Low	D					Stable
Tier 2 Birds <i>Bucephala islandica</i>				Southern Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>	
						Wetlands	<input checked="" type="checkbox"/>	
						Colorado Plateau - Wyoming Basins Rivers		<input type="checkbox"/>
						Colorado Plateau - Wyoming Basins Streams		<input type="checkbox"/>
						Mountain Streams		<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
05.3 Logging & Wood Harvesting	Altered native vegetation (salvage logging removing cavity trees)	2.1 Site/Area Management	Implement compatible forest management practices	L

Black rosy-finch		Population Status and Trend		Distribution	Type	Habitat	Primary
		Low	D				
Tier 2 Birds <i>Leucosticte atrata</i>				Southern Rocky Mountains	O	Alpine	<input checked="" type="checkbox"/>
				Utah-Wyoming Rocky Mountains	O	Sagebrush	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.2 Mining & Quarrying	Mining operations	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
07.3 Other Ecosystem Modifications	Habitat degradation	2.3 Habitat & Natural Process Restoration	Restore mixed conifer winter habitat, including fire mitigation and insect outbreak mitigation	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L
14.4 Predation	Nest predation (increased by Common Ravens drawn above treeline by trash)	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L

Table 7 - Continued.

Black swift

Population Status and Trend		Distribution	Type	Habitat	Primary	
Low	D	Stable	D	Southern Rocky Mountains	P	Cliffs and Canyons <input checked="" type="checkbox"/>
						Colorado Plateau - Wyoming Basins Streams <input checked="" type="checkbox"/>
						Mountain Streams <input checked="" type="checkbox"/>

Cypseloides niger

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Rock climbing	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
11.1 Habitat Shifting & Alteration	Potential for degradation of nesting habitat related to climate impacts on water resources	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
13.6 Response to change, disturbance, & other threats poorly understood	Lack of monitoring plan	8.0 Research & Monitoring	Research population parameters and/or monitor status	M

Black tern

Population Status and Trend		Distribution	Type	Habitat	Primary	
Low	X	Stable	X	Southern Rocky Mountains	P	Wetlands <input checked="" type="checkbox"/>

Chlidonias niger

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Drainage of wetlands for agriculture	5.4 Compliance & Enforcement	Enforce 404 wetlands regulations	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M

Bobolink

Population Status and Trend		Distribution	Type	Habitat	Primary	
Low	D	Stable	D	Central Shortgrass Prairie	P	Agriculture <input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Foothill and Mountain <input checked="" type="checkbox"/>
				Utah High Plateau	P	Grasslands <input checked="" type="checkbox"/>
				Wyoming Basin	O	Mixed and Tallgrass Prairies <input checked="" type="checkbox"/>
						Conservation Reserve Program <input type="checkbox"/>

Dolichonyx oryzivorus

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.3 Other Ecosystem Modifications	Decrease in hay field area, earlier/more frequent hay-cropping, shift in vegetative structure	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context (e.g., delayed haying)	M

Boreal owl

Population Status and Trend		Distribution	Type	Habitat	Primary	
Medium	X	Declining	X	Southern Rocky Mountains	P	Lodgepole Pine <input checked="" type="checkbox"/>
						Spruce - Fir <input checked="" type="checkbox"/>
						Aspen <input type="checkbox"/>
						Pinyon - Juniper <input type="checkbox"/>
						Ponderosa Pine <input type="checkbox"/>
						Subalpine Limber - Bristlecone Pine <input type="checkbox"/>

Aegolius funereus

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Potential for heat stress & habitat degradation related to increased temperatures, worsening wildfires	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
13.4 Population status unknown	Status estimated as medium, but additional data are needed	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
05.3 Logging & Wood Harvesting	Altered native vegetation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	L

Table 7 - Continued.

Brewer's sparrow

Spizella breweri

Tier 2 Birds

Population Status and Trend		Distribution	Type	Habitat	Primary	
Abundant	D	Declining	D	Central Shortgrass Prairie	P	Sagebrush <input checked="" type="checkbox"/>
				Colorado Plateau	P	Agriculture <input type="checkbox"/>
				Front Range	P	Conservation Reserve Program <input type="checkbox"/>
				Southern Rocky Mountains	P	Desert Shrub <input type="checkbox"/>
				Utah High Plateau	P	Greasewood <input type="checkbox"/>
				Utah-Wyoming Rocky Mountains	P	Saltbush <input type="checkbox"/>
				Wyoming Basin	P	Sandsage <input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	H
02.3 Livestock Farming & Ranching	Altered native vegetation (burning, herbicide, or mechanical sagebrush removal)	2.1 Site/Area Management	Implement compatible grazing practices	H
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	2.1 Site/Area Management	Employ grazing as a tool for compatible vegetation cover, structure, composition	H
07.3 Other Ecosystem Modifications	Habitat degradation from a variety of sources	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseeded of native species, and maintenance of appropriate patch size and habitat mosaic	M
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
03.1 Oil & Gas Drilling	Oil & Gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
07.3 Other Ecosystem Modifications	Habitat degradation from a variety of threats	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseeded of native species, and maintenance of appropriate patch size and habitat mosaic	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
02.3 Livestock Farming & Ranching	Range improvement operations	2.1 Site/Area Management	Implement compatible grazing practices	L
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L

Table 7 - Continued.

Cassin's finch		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Medium	D	Declining	D	Colorado Plateau	P	Aspen	<input checked="" type="checkbox"/>
						Front Range	P	Lodgepole Pine	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Mixed Conifer	<input checked="" type="checkbox"/>
						Utah High Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains	P	Ponderosa Pine	<input checked="" type="checkbox"/>
						Central Shortgrass Prairie	O	Spruce - Fir	<input checked="" type="checkbox"/>
						Wyoming Basin	O	Subalpine Limber - Bristlecone Pine	<input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research population parameters and/or monitor status	M				

Cassin's sparrow		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Medium	D	Declining	D	Central Shortgrass Prairie	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
						Front Range	O	Sandsage	<input checked="" type="checkbox"/>
								Shortgrass Prairie	<input checked="" type="checkbox"/>
								Agriculture	<input type="checkbox"/>
								Conservation Reserve Program	<input type="checkbox"/>
								Sagebrush	<input type="checkbox"/>
								Upland Shrub	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M				
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.1 Site/Area Management		Implement compatible grazing practices	M				
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations		Promote zoning that concentrates use and protects habitat	L				

Chestnut-collared longspur		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Low	D	Unknown	X	Central Shortgrass Prairie	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
								Shortgrass Prairie	<input checked="" type="checkbox"/>
								Agriculture	<input type="checkbox"/>
								Conservation Reserve Program	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	H				
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	M				
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing practices	M				
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M				
11.4 Storms & Flooding	Climate variability (prolonged rain events and cold weather can cause nest failure)	8.0 Research & Monitoring		Research population parameters and/or monitor status	L				
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	L				
14.4 Predation	Predation	8.0 Research & Monitoring		Research population parameters and/or monitor status	L				

Table 7 - Continued.

Ferruginous hawk		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Low	D					Stable
Tier 2	Birds			Central Shortgrass Prairie	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>	
				Utah-Wyoming Rocky Mountains	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>	
				Wyoming Basin	P	Shortgrass Prairie	<input checked="" type="checkbox"/>	
				Colorado Plateau	O	Agriculture	<input type="checkbox"/>	
				Front Range	O	Cliffs and Canyons	<input type="checkbox"/>	
				Southern Rocky Mountains	O	Conservation Reserve Program	<input type="checkbox"/>	
				Utah High Plateau	O	Desert Shrub	<input type="checkbox"/>	
						Greasewood	<input type="checkbox"/>	
						Pinyon - Juniper	<input type="checkbox"/>	
						Sagebrush	<input type="checkbox"/>	
				Saltbush	<input type="checkbox"/>			
				Sandsage	<input type="checkbox"/>			
				Upland Shrub	<input type="checkbox"/>			
General Threat		Specific Threat		General Conservation Action		Specific Conservation Action		Priority
01.1 Housing & Urban Areas		Urban, suburban, and ex-urban development		1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		M
03.1 Oil & Gas Drilling		Oil & gas development, pipelines, and infrastructure		5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Secondary poisoning (anticoagulants, lead shot)		5.2 Policies & Regulations		Monitor for potential impacts and respond as warranted by local conditions		M
08.4 Pathogens		Loss of prairie dog colonies due to sylvatic plague		8.0 Research & Monitoring		Research species/habitat response to plague management		M
03.3 Renewable Energy		Collision with wind turbines		5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		L
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Mortality and prey reduction through rodent control		4.3 Awareness & Communications		Implement landowner outreach/education program		L
06.1 Recreational Activities		Motorized and non-motorized recreation, proximal non-recreation disturbance of nest locations		4.3 Awareness & Communications		Implement landowner outreach/education program		L
08.1 Invasive Non-Native/Alien Species		Invasive plants - cheatgrass, Russian thistle		2.2 Invasive/Problematic Species Control		Write and/or implement integrated weed/pest management plan		L
Flammulated owl		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Unknown	X					Unknown
Tier 2	Birds			Colorado Plateau	P	Aspen	<input checked="" type="checkbox"/>	
				Southern Rocky Mountains	P	Ponderosa Pine	<input checked="" type="checkbox"/>	
				Utah High Plateau	P	Mixed Conifer	<input type="checkbox"/>	
				Front Range	O	Spruce - Fir	<input type="checkbox"/>	
				Utah-Wyoming Rocky Mountains	O	Subalpine Limber - Bristlecone Pine	<input type="checkbox"/>	
				Wyoming Basin	O			
General Threat		Specific Threat		General Conservation Action		Specific Conservation Action		Priority
09.3 Agricultural & Forestry Effluents		Herbicide/pesticide spraying or runoff		5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production		M
05.3 Logging & Wood Harvesting		Altered native vegetation (salvage logging removing cavity trees)		2.1 Site/Area Management		Implement compatible forest management practices		L
08.1 Invasive Non-Native/Alien Species		Invasive animals - European starlings		2.2 Invasive/Problematic Species Control		Maintain appropriate patch size and habitat mosaic		L
13.4 Population status unknown		Lack of data on population status		8.0 Research & Monitoring		Research population parameters and/or monitor status		L
13.5 Population trend unknown		Lack of data on population trend		8.0 Research & Monitoring		Research population parameters and/or monitor status		L
14.3 Low reproductive rate		Low reproductive rate		8.0 Research & Monitoring		Research population parameters and/or monitor status		L

Table 7 - Continued.

Grace's warbler

Population Status and Trend		Distribution	Type	Habitat	Primary		
Low	D	Unknown	X	Colorado Plateau	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	O	Ponderosa Pine	<input checked="" type="checkbox"/>

Setophaga graciae

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
07.1 Fire & Fire Suppression	Altered fire regime (fire suppression leading to high intensity fires)	2.3 Habitat & Natural Process Restoration	Restore natural fire regime and mountain shrub/ponderosa pine habitats	M
05.3 Logging & Wood Harvesting	Altered native vegetation (clearcutting)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for forestry	L
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Grasshopper sparrow

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	D	Declining	D	Central Shortgrass Prairie	P	Conservation Reserve Program	<input checked="" type="checkbox"/>
				Front Range	O	Shortgrass Prairie	<input checked="" type="checkbox"/>

Ammodramus savannarum

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Gray vireo

Population Status and Trend		Distribution	Type	Habitat	Primary		
Low	D	Unknown	X	Central Shortgrass Prairie	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
				Colorado Plateau	P		
				Utah High Plateau	P		
				Southern Rocky Mountains	O		
				Utah-Wyoming Rocky Mountains	O		
				Wyoming Basin	O		

Vireo vicinior

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity, tree/shrub clearing)	2.1 Site/Area Management	Implement compatible grazing practices	M
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
05.3 Logging & Wood Harvesting	Natural system modification - illegal firewood cutting	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	L
08.2 Problematic Native Species	Habitat loss due to insect damage and fire	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Table 7 - Continued.

Greater prairie-chicken		Population Status and Trend		Distribution	Type	Habitat	Primary
	Medium	D	Stable	D	Central Shortgrass Prairie	P	Agriculture <input checked="" type="checkbox"/>
							Sandsage <input checked="" type="checkbox"/>
							Conservation Reserve Program <input type="checkbox"/>
<i>Tympanuchus cupido</i>							
Tier 2 Birds							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic		H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			2.1 Site/Area Management	Implement compatible grazing practices		H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs		H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)		H
03.1 Oil & Gas Drilling	Behavioral avoidance of oil & gas development and associated infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		H
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil & gas development and associated infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		H
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats		H
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		H
03.3 Renewable Energy	Behavioral avoidance of renewable energy development and associated infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		H
03.3 Renewable Energy	Fragmentation of native habitat due to renewable energy development and associated infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		H
03.3 Renewable Energy	Renewable energy development			5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats		H
03.3 Renewable Energy	Renewable energy development			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		M
07.3 Other Ecosystem Modifications	Fragmentation of native prairie			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass			2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context		M
08.2 Problematic Native Species	Predation and parasites			8.0 Research & Monitoring	Research population parameters and/or monitor status		M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff			5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production		M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate		M
11.2 Droughts	Lack of water due to drought and exacerbated by climate change			2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic		M

Table 7 - Continued.

Juniper titmouse

Population Status and Trend		Distribution	Type	Habitat	Primary	
Medium	D	Declining	D	Central Shortgrass Prairie Colorado Plateau Southern Rocky Mountains Utah High Plateau Utah-Wyoming Rocky Mountains Wyoming Basin	P P P P P P	Pinyon - Juniper <input checked="" type="checkbox"/>

Baeolophus ridgwayi

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity, tree/shrub clearing)	2.1 Site/Area Management	Implement compatible grazing practices	M
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
05.3 Logging & Wood Harvesting	Natural system modification - illegal firewood cutting, commercial pinon nut collecting	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	L
08.2 Problematic Native Species	Habitat loss due to insect damage and fire	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L

Lark bunting

Population Status and Trend		Distribution	Type	Habitat	Primary		
Low	D	Declining	D	Central Shortgrass Prairie Front Range Southern Rocky Mountains Utah High Plateau Wyoming Basin Colorado Plateau Utah-Wyoming Rocky Mountains	P P P P P O O	Agriculture Desert Shrub Mixed and Tallgrass Prairies Shortgrass Prairie Conservation Reserve Program Foothill and Mountain Grasslands Playas Sagebrush	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Calamospiza melanocorys

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Intensive agricultural operations	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff (grasshopper control)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
02.3 Livestock Farming & Ranching	Mortality at stock tanks from drowning	5.3 Private Sector Standards & Codes	Implement Best Management Practices for livestock grazing	L

Table 7 - Continued.

Lazuli bunting		Population Status and Trend		Distribution	Type	Habitat	Primary
		Medium	D				
Tier 2	Birds					Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
						Pinyon - Juniper	<input checked="" type="checkbox"/>
						Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
						Sagebrush	<input checked="" type="checkbox"/>
						Upland Shrub	<input checked="" type="checkbox"/>
						Aspen	<input type="checkbox"/>
						Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
						Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
						Eastern Plains Rivers	<input type="checkbox"/>
						Eastern Plains Streams	<input type="checkbox"/>
						Mountain Streams	<input type="checkbox"/>
						Transition Streams	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.3 Other Ecosystem Modifications	Altered native vegetation	2.3 Habitat & Natural Process Restoration	Plant native trees/shrubs	L

Least tern		Population Status and Trend		Distribution	Type	Habitat	Primary
		Low	D				
Tier 2	Birds					Playas	<input checked="" type="checkbox"/>
						Reservoirs and Shorelines	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk	2.2 Invasive/Problematic Species Control	Remove tamarisk through biological, chemical, mechanical means and prevent re-establishment via water management and physical/chemical control	H
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
02.3 Livestock Farming & Ranching	Egg trampling	2.1 Site/Area Management	Implement compatible grazing practices	M
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	M
09.1 Household Sewage & Urban Waste Water	Water pollution	5.2 Policies & Regulations	Monitor water quality standards	M
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L
07.2 Dams & Water Management/Use	Decreased water quality and/or quantity (water level, desalination projects)	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	L
14.4 Predation	Predation	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Table 7 - Continued.

Lewis's woodpecker		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Medium	D	Declining	X	Central Shortgrass Prairie	P	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
						Front Range	p	Eastern Plains Rivers	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	p	Eastern Plains Streams	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains	O	Pinyon - Juniper	<input checked="" type="checkbox"/>
						Wyoming Basin	O	Ponderosa Pine	<input checked="" type="checkbox"/>
								Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
								Transition Streams	<input checked="" type="checkbox"/>
								Agriculture	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
05.3 Logging & Wood Harvesting	Altered native vegetation (removal of snags)	2.1 Site/Area Management	Implement compatible forest management practices	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
07.3 Other Ecosystem Modifications	Habitat degradation	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	M
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing practices	L
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	L

Loggerhead shrike		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Medium	D	Stable	D	Central Shortgrass Prairie	P	Desert Shrub	<input checked="" type="checkbox"/>
						Colorado Plateau	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
						Front Range	p	Grasslands	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	p	Greasewood	<input checked="" type="checkbox"/>
						Utah High Plateau	p	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains	p	Sagebrush	<input checked="" type="checkbox"/>
						Wyoming Basin	P	Saltbush	<input checked="" type="checkbox"/>
								Sandsage	<input checked="" type="checkbox"/>
		Shortgrass Prairie	<input checked="" type="checkbox"/>						
		Agriculture	<input type="checkbox"/>						

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M

Table 7 - Continued.

Long-billed curlew		Population Status and Trend		Distribution	Type	Habitat	Primary
		Low	D				
Tier 2	Birds					Central Shortgrass Prairie	<input checked="" type="checkbox"/>
						Front Range	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	<input type="checkbox"/>
						Wyoming Basin	<input type="checkbox"/>
						Eastern Plains Rivers	<input type="checkbox"/>
						Eastern Plains Streams	<input type="checkbox"/>
						Mixed and Tallgrass Prairies	<input type="checkbox"/>
Sandsage	<input type="checkbox"/>						
Wetlands	<input type="checkbox"/>						

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection. Playa conservation would benefit this species.	M
02.3 Livestock Farming & Ranching	Altered native vegetation (degradation of native shortgrass prairie)	2.1 Site/Area Management	Implement compatible grazing practices	M
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
09.3 Agricultural & Forestry Effluents	General water pollution, herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L

McCown's longspur		Population Status and Trend		Distribution	Type	Habitat	Primary
		Low	D				
Tier 2	Birds					Central Shortgrass Prairie	<input checked="" type="checkbox"/>
						Agriculture	<input type="checkbox"/>
						Conservation Reserve Program	<input type="checkbox"/>
						Playas	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.3 Livestock Farming & Ranching	Altered native vegetation (degradation of native shortgrass prairie)	2.1 Site/Area Management	Implement compatible grazing practices	M
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
14.4 Predation	Nest predation	2.1 Site/Area Management	Implement compatible grazing practices	M
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Table 7 - Continued.

Mexican spotted owl

		Population Status and Trend		Distribution	Type	Habitat	Primary		
Tier 2	Birds	Low	D	Unknown	X	Colorado Plateau	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Mixed Conifer	<input checked="" type="checkbox"/>
						Central Shortgrass Prairie	O	Pinyon - Juniper	<input checked="" type="checkbox"/>
						Front Range	O	Ponderosa Pine	<input checked="" type="checkbox"/>
								Transition Streams	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.2 Mining & Quarrying	Rock mining in nesting & winter habitat in El Paso and Fremont counties	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
04.4 Flight Paths	Low-flying military jets and helicopters	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs - work with the Army on Integrated Natural Resource Management Plan	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
05.3 Logging & Wood Harvesting	Altered native vegetation (even-age timber management)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for forestry	L

Table 7 - Continued.

Northern bobwhite

Population Status and Trend		Distribution	Type	Habitat	Primary	
Low	X	Declining	X	Central Shortgrass Prairie	P	Agriculture <input checked="" type="checkbox"/>
				Riparian Woodlands and Shrublands		<input checked="" type="checkbox"/>
				Sandsage		<input checked="" type="checkbox"/>
				Conservation Reserve Program		<input type="checkbox"/>
				Eastern Plains Streams		<input type="checkbox"/>
				Mixed and Tallgrass Prairies		<input type="checkbox"/>

Colinus virginianus

Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation	2.1 Site/Area Management	Implement compatible grazing practices	H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing practices	H
02.3 Livestock Farming & Ranching	Reduced grass/forb diversity	2.1 Site/Area Management	Implement compatible grazing practices	H
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk, cheatgrass, Canada thistle, leafy spurge	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	H
11.2 Droughts	Lack of water for habitat	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	H
11.4 Storms & Flooding	Blizzards and impact of hail and flooding on chicks and adults	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	H
02.3 Livestock Farming & Ranching	Altered native vegetation	8.0 Research & Monitoring	Research species/habitat response to management	M
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	8.0 Research & Monitoring	Research species/habitat response to management	M
02.3 Livestock Farming & Ranching	Reduced grass/forb diversity	8.0 Research & Monitoring	Research species/habitat response to management	M
07.2 Dams & Water Management/Use	Seral state imbalance - suppression of early seral stages	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	M
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation, denuding of wetland vegetation)	2.3 Habitat & Natural Process Restoration	Plant native trees/shrubs	M
08.2 Problematic Native Species	Predation and parasites	8.0 Research & Monitoring	Research impact of parasites on bird survival	M
02.3 Livestock Farming & Ranching	Egg trampling	8.0 Research & Monitoring	Research species/habitat response to management	L
08.2 Problematic Native Species	Predation and parasites	3.2 Species Recovery	Reduce nest predators	L

Table 7 - Continued.
Olive-sided flycatcher

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	D	Unknown	X	Colorado Plateau	P	Aspen	<input checked="" type="checkbox"/>
		Southern Rocky Mountains	P	Lodgepole Pine			<input checked="" type="checkbox"/>
		Front Range	O	Mixed Conifer			<input checked="" type="checkbox"/>
		Utah High Plateau	O	Pinyon - Juniper			<input checked="" type="checkbox"/>
				Ponderosa Pine			<input checked="" type="checkbox"/>
				Spruce - Fir			<input checked="" type="checkbox"/>
				Subalpine Limber - Bristlecone Pine			<input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	M			
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M			
05.3 Logging & Wood Harvesting	Altered native vegetation (removal of snags)	2.1 Site/Area Management	Implement compatible forest management practices	L			
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L			

Pinyon jay

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	D	Declining	D	Central Shortgrass Prairie	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
		Colorado Plateau	P	Ponderosa Pine			<input checked="" type="checkbox"/>
		Southern Rocky Mountains	P	Subalpine Limber - Bristlecone Pine			<input checked="" type="checkbox"/>
		Utah High Plateau	P				
		Front Range	O				
		Utah-Wyoming Rocky Mountains	O				
		Wyoming Basin	O				
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority			
02.3 Livestock Farming & Ranching	Altered native vegetation (incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M			
02.3 Livestock Farming & Ranching	Tree removal	2.1 Site/Area Management	Implement compatible grazing practices	M			
08.2 Problematic Native Species	Habitat loss due to insect damage and fire	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L			

Piping plover

Population Status and Trend		Distribution	Type	Habitat	Primary		
Low	D	Stable	D	Central Shortgrass Prairie	P	Playas	<input checked="" type="checkbox"/>
				Reservoirs and Shorelines			<input checked="" type="checkbox"/>
				Wetlands			<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority			
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk	2.2 Invasive/Problematic Species Control	Remove tamarisk through biological, chemical, mechanical means and prevent re-establishment	H			
06.1 Recreational Activities	Motorized and non-motorized recreation	3.1 Species Management	Implement existing management/recovery plan	M			
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness (e.g., use beach-nesting bird signs)	M			
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	M			
09.3 Agricultural & Forestry Effluents	General water pollution, herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M			
14.4 Predation	Predation	8.0 Research & Monitoring	Research population parameters and/or monitor status	L			

Table 7 - Continued.

Prairie falcon

Falco mexicanus
Tier 2 Birds

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	D	Unknown	X	Central Shortgrass Prairie	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
				Colorado Plateau	P	Foothill and Mountain	<input checked="" type="checkbox"/>
				Front Range	p	Grasslands	
				Southern Rocky Mountains	p	Shortgrass Prairie	<input checked="" type="checkbox"/>
				Utah High Plateau	p	Agriculture	<input type="checkbox"/>
				Utah-Wyoming Rocky Mountains	p	Alpine	<input type="checkbox"/>
				Wyoming Basin	O	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
						Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
						Conservation Reserve Program	<input type="checkbox"/>
						Desert Shrub	<input type="checkbox"/>
						Eastern Plains Rivers	<input type="checkbox"/>
						Eastern Plains Streams	<input type="checkbox"/>
						Greasewood	<input type="checkbox"/>
						Mixed and Tallgrass Prairies	<input type="checkbox"/>
						Mountain Streams	<input type="checkbox"/>
						Pinyon - Juniper	<input type="checkbox"/>
						Playas	<input type="checkbox"/>
						Sagebrush	<input type="checkbox"/>
						Saltbush	<input type="checkbox"/>
						Sandsage	<input type="checkbox"/>
						Transition Streams	<input type="checkbox"/>
						Wetlands	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	M
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
06.1 Recreational Activities	Rock climbing, hiking near cliffs and crevices	2.1 Site/Area Management	Establish exclusionary/boundary fencing, formal wildlife viewing stations/areas, signage to raise public awareness, seasonal closures	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
03.3 Renewable Energy	Collision with wind turbines	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Purple martin

Progne subis
Tier 2 Birds

Population Status and Trend		Distribution	Type	Habitat	Primary		
Low	D	Unknown	X	Colorado Plateau	P	Aspen	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
				Utah High Plateau	p	Mountain Streams	<input type="checkbox"/>
				Wyoming Basin	O		

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.1 Oil & Gas Drilling	Altered native vegetation (loss of older aspen stands from gas development)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L
05.3 Logging & Wood Harvesting	Altered native vegetation (loss of older aspen stands from logging)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for forestry	L
07.3 Other Ecosystem Modifications	Altered native vegetation (loss of older aspen stands from logging and gas development)	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	L
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Table 7 - Continued.

Rufous hummingbird		Population Status and Trend		Distribution	Type	Habitat	Primary		
<i>Selasphorus rufus</i>	Tier 2 Birds	Medium	D	Unknown	X	Central Shortgrass Prairie	O	Alpine	<input checked="" type="checkbox"/>
						Colorado Plateau	O	Foothill and Mountain	<input checked="" type="checkbox"/>
						Front Range	O	Grasslands	
						Southern Rocky Mountains	O	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
						Utah High Plateau	O	Upland Shrub	<input checked="" type="checkbox"/>
						Utah-Wyoming Rocky Mountains	O		
						Wyoming Basin	O		
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority					
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L					

Sage sparrow		Population Status and Trend		Distribution	Type	Habitat	Primary		
<i>Amphispiza belli</i>	Tier 2 Birds	Medium	X	Declining	X	Colorado Plateau	P	Greasewood	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>
						Utah High Plateau	P	Conservation Reserve Program	<input type="checkbox"/>
						Utah-Wyoming Rocky Mountains	P		
						Wyoming Basin	P		
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority					
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	H					
02.3 Livestock Farming & Ranching	Altered native vegetation (burning, herbicide, or mechanical sagebrush removal)	2.1 Site/Area Management	Implement compatible grazing practices	H					
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.1 Site/Area Management	Employ grazing as a tool for compatible vegetation cover, structure, composition	H					
07.3 Other Ecosystem Modifications	Habitat degradation from variety of sources	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H					
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M					
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	2.3 Habitat & Natural Process Restoration	Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseeded of native species, and maintenance of appropriate patch size and habitat mosaic	M					
02.3 Livestock Farming & Ranching	Altered native vegetation (sagebrush removal, incompatible timing, intensity, duration of grazing)	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M					
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M					
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M					

Table 7 - Continued.

Short-eared owl

Population Status and Trend		Distribution	Type	Habitat	Primary		
Low	D	Declining	D	Central Shortgrass Prairie	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
				Colorado Plateau	O	Sagebrush	<input checked="" type="checkbox"/>
				Front Range	O	Sandsage	<input checked="" type="checkbox"/>
						Shortgrass Prairie	<input checked="" type="checkbox"/>
						Upland Shrub	<input checked="" type="checkbox"/>
						Wetlands	<input checked="" type="checkbox"/>
						Agriculture	<input type="checkbox"/>

Asio flammeus
Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
05.3 Logging & Wood Harvesting	Altered native vegetation	5.3 Private Sector Standards & Codes	Implement Best Management Practices for forestry	M
14.5 Competition	Predation and competition (Barn owls)	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L
07.3 Other Ecosystem Modifications	Altered native vegetation (wetland loss)	5.4 Compliance & Enforcement	Enforce 404 wetlands regulations	L

Swainson's hawk

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	D	Declining	D	Central Shortgrass Prairie	P	Agriculture	<input checked="" type="checkbox"/>
				Colorado Plateau	P	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
				Front Range	P	Desert Shrub	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
				Wyoming Basin	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
				Utah High Plateau	O	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
						Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
						Playas	<input checked="" type="checkbox"/>
						Sagebrush	<input checked="" type="checkbox"/>
						Saltbush	<input checked="" type="checkbox"/>
						Sandsage	<input checked="" type="checkbox"/>
						Shortgrass Prairie	<input checked="" type="checkbox"/>
						Upland Shrub	<input checked="" type="checkbox"/>
						Conservation Reserve Program	<input type="checkbox"/>

Buteo swainsoni
Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Implement landowner outreach/education program	M
03.3 Renewable Energy	Collision with wind turbines	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Mortality and prey reduction through rodent control	4.3 Awareness & Communications	Implement landowner outreach/education program	L

Table 7 - Continued.

Upland sandpiper		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	D	Unknown	X	Central Shortgrass Prairie	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
						Agriculture	<input type="checkbox"/>
						Sandsage	<input type="checkbox"/>
<i>Bartramia longicauda</i>							
Tier 2 Birds							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M		
02.1 Annual & Perennial Non-Timber Crops	Early/often pasture and hayfield cutting (nest destruction)	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M		
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	L		
Veery		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	D	Unknown	X	Southern Rocky Mountains	P	Riparian Woodlands and	<input checked="" type="checkbox"/>
				Front Range	O	Shrublands	
<i>Catharus fuscescens</i>							
Tier 2 Birds							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.3 Other Ecosystem Modifications	Habitat degradation	2.3 Habitat & Natural Process Restoration		Restore native habitat using site-appropriate techniques and context	M		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	L		
Virginia's warbler		Population Status and Trend		Distribution	Type	Habitat	Primary
Medium	D	Stable	D	Colorado Plateau	P	Mixed Conifer	<input checked="" type="checkbox"/>
				Front Range	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
				Utah High Plateau	P	Ponderosa Pine	<input checked="" type="checkbox"/>
				Utah-Wyoming Rocky Mountains	P	Upland Shrub	<input checked="" type="checkbox"/>
				Central Shortgrass Prairie	O	Aspen	<input type="checkbox"/>
				Wyoming Basin	O	Subalpine Limber - Bristlecone Pine	<input type="checkbox"/>
						Transition Streams	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.3 Other Ecosystem Modifications	Habitat degradation	2.3 Habitat & Natural Process Restoration		Restore native habitat using site-appropriate techniques and context	M		
14.4 Predation	Predation	8.0 Research & Monitoring		Research population parameters and/or monitor status	M		
Western snowy plover		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	D	Unknown	X	Central Shortgrass Prairie	P	Reservoirs and Shorelines	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P		
<i>Charadrius alexandrinus nivosus</i>							
Tier 2 Birds							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness (e.g., use beach-nesting bird signs)	M		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	5.3 Private Sector Standards & Codes		Implement Best Management Practices for water resource development	M		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	L		

Table 7 - Continued.

White-faced ibis

Population Status and Trend		Distribution	Type	Habitat	Primary		
Low	D	Increasing	D	Central Shortgrass Prairie	P	Agriculture	<input checked="" type="checkbox"/>
				Colorado Plateau	P	Colorado Plateau - Wyoming	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Basins Rivers	<input checked="" type="checkbox"/>
				Utah-Wyoming Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>
						Playas	<input checked="" type="checkbox"/>
						Reservoirs and Shorelines	<input checked="" type="checkbox"/>
						Wetlands	<input checked="" type="checkbox"/>

Plegadis chihi
Tier 2 Birds

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Motorized and non-motorized recreation	4.3 Awareness & Communications	Implement landowner outreach/education program	M
07.2 Dams & Water Management/Use	Altered hydrological regime (fluctuating water levels)	3.1 Species Management	Develop collaborative management agreements	M
07.3 Other Ecosystem Modifications	Natural system modification - wetland degradation	5.2 Policies & Regulations	Encourage use of Farm Bill programs for playas	M
07.3 Other Ecosystem Modifications	Natural system modification - wetland degradation	5.4 Compliance & Enforcement	Enforce 404 wetlands regulations	M
09.1 Household Sewage & Urban Waste Water	Water pollution	5.2 Policies & Regulations	Monitor water quality standards	M

Whooping crane

Population Status and Trend		Distribution	Type	Habitat	Primary
		Central Shortgrass Prairie	O	Agriculture	<input checked="" type="checkbox"/>
				Wetlands	<input checked="" type="checkbox"/>

Grus americana
Tier 2 Birds

Not known to have breeding population in Colorado (no primary habitat, status, or trends).

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
04.2 Utility & Service Lines	Collision with wind turbines	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L

Tier 2 Fish

Iowa darter

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	D	Stable	D	Central Shortgrass Prairie	P	Eastern Plains Rivers	<input checked="" type="checkbox"/>
				Front Range	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
						Transition Streams	<input checked="" type="checkbox"/>

Etheostoma exile
Tier 2 Fish

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - wetland drainage	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Identify and control point-source and non-point source pollution	M
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	L

Table 7 - Continued.

Lake chub

Population Status and Trend		Distribution	Type	Habitat	Primary	
Medium	D	Stable	D	Front Range Southern Rocky Mountains	P P	Lakes <input checked="" type="checkbox"/>

Couesius plumbeus

Tier 2 Fish

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - stream dewatering	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using integrated pest management techniques for aquatic habitats	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff and nonpoint source pollution	2.3 Habitat & Natural Process Restoration	Identify and control point-source and non-point source pollution	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Gathering for bait or aquarium trade	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	L

Tier 2 Mammals

Abert's squirrel

Population Status and Trend		Distribution	Type	Habitat	Primary
Unknown	Unknown	Southern Rocky Mountains Colorado Plateau	P O	Ponderosa Pine	<input checked="" type="checkbox"/>

Sciurus aberti

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
08.2 Problematic Native Species	Habitat loss / degradation due to beetle kill	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Allen's big-eared bat

Population Status and Trend		Distribution	Type	Habitat	Primary
Unknown	X	Colorado Plateau		Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
	X	Recently documented in Colorado.		Pinyon - Juniper	<input checked="" type="checkbox"/>

Idionycteris phyllotis

Tier 2 Mammals

				Ponderosa Pine	<input checked="" type="checkbox"/>
				Cliffs and Canyons	<input type="checkbox"/>
				Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
				Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
				Mixed Conifer	<input type="checkbox"/>
				Sagebrush	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M

Table 7 - Continued.

American marten		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Unknown	X	Unknown	X	Southern Rocky Mountains	P	Lodgepole Pine	<input checked="" type="checkbox"/>
							Spruce - Fir	<input checked="" type="checkbox"/>
							Alpine	<input type="checkbox"/>
<i>Martes americana</i>								
Tier 2 Mammals								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority	
05.3 Logging & Wood Harvesting	Clearcutting and even-aged forest management			2.1 Site/Area Management	Implement compatible forest management		M	
05.3 Logging & Wood Harvesting	Replacement of mature/old growth with younger, more even-aged stands			2.1 Site/Area Management	Implement compatible forest management		M	
08.2 Problematic Native Species	Habitat loss / degradation due to beetle kill			8.0 Research & Monitoring	Research species/habitat response to management		M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate		M	
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring	Research population parameters and/or monitor status		M	
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring	Research population parameters and/or monitor status		M	
Big free-tailed bat		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Unknown		Unknown	Central Shortgrass Prairie	O	Cliffs and Canyons	<input checked="" type="checkbox"/>	
				Colorado Plateau	O	Desert Shrub	<input checked="" type="checkbox"/>	
				Front Range	O	Pinyon - Juniper	<input checked="" type="checkbox"/>	
				Southern Rocky Mountains	O			
<i>Nyctinomops macrotis</i>								
Tier 2 Mammals								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		H	
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring	Research population parameters and/or monitor status		M	
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring	Research population parameters and/or monitor status		M	

Table 7 - Continued.

Bighorn sheep		Population Status and Trend		Distribution	Type	Habitat	Primary
		Medium	D				
<i>Ovis canadensis</i> Tier 2 Mammals				Southern Rocky Mountains	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
				Central Shortgrass Prairie	O	Alpine	<input type="checkbox"/>
				Colorado Plateau	O	Foothill and Mountain	<input type="checkbox"/>
				Wyoming Basin	O	Grasslands	
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority	
01.1 Housing & Urban Areas	Transmission of pathogens by hobby livestock			4.3 Awareness & Communications	Implement landowner outreach/education program	H	
01.1 Housing & Urban Areas	Transmission of pathogens by hobby livestock			4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
01.1 Housing & Urban Areas	Transmission of pathogens by hobby livestock			5.2 Policies & Regulations	Promote zoning that concentrates use and prevents disease transmission	H	
02.3 Livestock Farming & Ranching	Altered native vegetation (riparian area deforestation, woody encroachment, chaining sagebrush, seral stage imbalance, etc.)			2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H	
02.3 Livestock Farming & Ranching	Transmission of pathogens			2.1 Site/Area Management	Implement compatible grazing practices	H	
08.4 Pathogens	Pathogen - respiratory disease caused by Pasteurellacea and Mycoplasma bacteria			8.0 Research & Monitoring	Research and develop effective vaccine and delivery system	H	
02.3 Livestock Farming & Ranching	Transmission of pathogens			5.2 Policies & Regulations	Allow authorities to remove stray domestic sheep and goats	M	
02.3 Livestock Farming & Ranching	Transmission of pathogens			5.3 Private Sector Standards & Codes	Implement Best Management Practices for livestock grazing	M	
06.1 Recreational Activities	Climbing, back country skiing			2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M	
07.1 Fire & Fire Suppression	Altered fire regime			2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M	
08.2 Problematic Native Species	Mountain lion predation			2.3 Habitat & Natural Process Restoration	Manage for predator/prey balance	M	
14.5 Competition	Competition with other native ungulates			2.3 Habitat & Natural Process Restoration	Manage natural herbivory	L	

Bison		Population Status and Trend		Distribution	Type	Habitat	Primary
<i>Bison bison</i> Tier 2 Mammals				Central Shortgrass Prairie		Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
				Southern Rocky Mountains		Shortgrass Prairie	<input checked="" type="checkbox"/>
				Wild populations extirpated. Currently classified as domestic species by Wildlife Commission Regulation – Ch. 11, Art. II, Sct 1103 A. US Fish & Wildlife Service lists possible re-introduction sites Baca NWR and Great Sand Dunes NP in Colorado.			

Table 7 - Continued.

Black-tailed prairie dog		Population Status and Trend		Distribution	Type	Habitat	Primary	
<i>Cynomys ludovicianus</i>	Tier 2	Mammals	Medium	D	Central Shortgrass Prairie Front Range	P	Shortgrass Prairie	<input checked="" type="checkbox"/>
			Stable	D		P	Mixed and Tallgrass Prairies	<input type="checkbox"/>
			Refer to existing conservation, management, and recovery plans or assessments for detailed discussion of threats and conservation actions needed.					
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority				
08.4 Pathogens	Pathogen - sylvatic plague	3.1 Species Management	Develop and implement an active disease management program	H				
08.4 Pathogens	Pathogen - sylvatic plague	8.0 Research & Monitoring	Research and develop effective vaccine and delivery system	H				
08.4 Pathogens	Pathogen - sylvatic plague	8.0 Research & Monitoring	Research species/habitat response to plague management	H				
01.1 Housing & Urban Areas	Urban, suburban, and exurban development	6.4 Conservation Payments	Support development and implementation of statewide habitat mitigation tool	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments	Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	7.3 Conservation Finance	Provide economic assistance for private land habitat improvements and/or species conservation	M				
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M				
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M				
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Poisoning	3.1 Species Management	Develop collaborative management agreements	M				
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Poisoning	4.3 Awareness & Communications	Implement landowner outreach/education program	M				
08.4 Pathogens	Pathogen - sylvatic plague	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M				
12.3 Lack of common goals	Greater collaboration among state and local agencies, and private industry, is warranted	5.2 Policies & Regulations	Improve alignment of conservation and management goals and practices across stakeholder groups	M				
06.1 Recreational Activities	Recreational shooting of prairie dogs	2.1 Site/Area Management	Implement shooting closures/seasons where local conditions warrant	L				

Table 7 - Continued.

**Botta's pocket gopher
(rubidus ssp)**

Population Status and Trend				Distribution	Type	Habitat	Primary
Medium	X	Unknown	X	Central Shortgrass Prairie Southern Rocky Mountains	P P	Foothill and Mountain Grasslands Pinyon - Juniper	<input checked="" type="checkbox"/> <input type="checkbox"/>

Thomomys bottae rubidus

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.3 Genetic relationship with other species and/or subspecies unknown	Genetic relationship with other subspecies unknown	8.0 Research & Monitoring	Research genetic relation to other (sub)species	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Poisoning	4.3 Awareness & Communications	Implement landowner outreach/education program	L

**Common hog-nosed
skunk**

Population Status and Trend				Distribution	Type	Habitat	Primary
Unknown	X	Unknown	X	Central Shortgrass Prairie Front Range	P P	Pinyon - Juniper Upland Shrub Desert Shrub	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>

Conepatus leuconotus

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Table 7 - Continued.

Hoary bat

Population Status and Trend		Distribution	Type	Habitat	Primary
Low	X	Unknown	X	Central Shortgrass Prairie	<input checked="" type="checkbox"/>
		Colorado Plateau		Aspen	<input checked="" type="checkbox"/>
		Front Range		Mixed Conifer	<input checked="" type="checkbox"/>
		Southern Rocky Mountains		Pinyon - Juniper	<input checked="" type="checkbox"/>
		Utah High Plateau		Ponderosa Pine	<input checked="" type="checkbox"/>
		Utah-Wyoming Rocky Mountains		Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
		Wyoming Basin		Spruce - Fir	<input checked="" type="checkbox"/>

Lasiurus cinereus

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.3 Renewable Energy	Collision with wind turbines	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
08.2 Problematic Native Species	Loss of roost sites (localized) due to beetle kill	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	M
08.4 Pathogens	Potential for White-nose Syndrome	2.2 Invasive/Problematic Species Control	Manage research, management, and recreation activities to control the spread of pathogens	M
08.2 Problematic Native Species	Habitat loss / degradation due to loss of roost sites (localized) due to beetle kill	5.3 Private Sector Standards & Codes	Implement Best Management Practices for forestry	L

Kit fox

Population Status and Trend		Distribution	Type	Habitat	Primary
		Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
				Greasewood	<input checked="" type="checkbox"/>
				Sagebrush	<input checked="" type="checkbox"/>
				Saltbush	<input checked="" type="checkbox"/>

Vulpes macrotis

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	OHV use in Peach Valley	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
07.3 Other Ecosystem Modifications	Decline of white-tailed prairie dogs, which provide den habitat and significant food source	2.3 Habitat & Natural Process Restoration	Improve status of white-tailed prairie dogs	L
14.1 Scarcity (leading to inbreeding depression)	Lack of wild populations	8.0 Research & Monitoring	Conduct primary research on potential for habitat restoration	L

Preble's shrew

Population Status and Trend		Distribution	Type	Habitat	Primary
Unknown	X	Unknown	X	Southern Rocky Mountains	<input checked="" type="checkbox"/>
		Colorado Plateau	O	Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
				Foothill and Mountain Grasslands	<input type="checkbox"/>
				Sagebrush	<input type="checkbox"/>

Sorex preblei

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H

Table 7 - Continued.

Pygmy rabbit		Population Status and Trend	Distribution	Type	Habitat	Primary
Unknown	Unknown	Wyoming Basin	P	Sagebrush	<input checked="" type="checkbox"/>	

Brachylagus idahoensis

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
02.3 Livestock Farming & Ranching	Reduced grass/forb diversity	2.3 Habitat & Natural Process Restoration	Re-seed native species	L
02.3 Livestock Farming & Ranching	Reduced grass/forb diversity	5.3 Private Sector Standards & Codes	Implement Best Management Practices for livestock grazing	L
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L
07.1 Fire & Fire Suppression	Altered fire regime and juniper encroachment	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

Pygmy shrew		Population Status and Trend	Distribution	Type	Habitat	Primary
Unknown	Unknown	Southern Rocky Mountains	P	Spruce - Fir Wetlands	<input checked="" type="checkbox"/>	
					<input checked="" type="checkbox"/>	

Sorex hoyi montanus

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H

Red-backed vole		Population Status and Trend	Distribution	Type	Habitat	Primary
Unknown	Unknown	Southern Rocky Mountains	P	Lodgepole Pine	<input checked="" type="checkbox"/>	
		Utah High Plateau	O	Mixed Conifer	<input checked="" type="checkbox"/>	

Clethrionomys gapperi

Tier 2 Mammals

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H

Table 7 - Continued.

River otter		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Medium	D	Increasing	D	Colorado Plateau	<input checked="" type="checkbox"/>	
						Southern Rocky Mountains		
						Utah-Wyoming Rocky Mountains	<input checked="" type="checkbox"/>	
						Central Shortgrass Prairie	<input type="checkbox"/>	
						Front Range	<input type="checkbox"/>	
						Eastern Plains Rivers	<input type="checkbox"/>	
						Eastern Plains Streams	<input type="checkbox"/>	
						Transition Streams	<input type="checkbox"/>	
						Wetlands	<input type="checkbox"/>	
General Threat		Specific Threat		General Conservation Action		Specific Conservation Action		Priority
05.1 Control of Nuisance Species & Collecting Terrestrial Animals		Potential for landowner "control" related to river otter impacts on fish ponds		4.3 Awareness & Communications		Implement landowner outreach/education program		M
07.2 Dams & Water Management/Use		Impact of reduced water quality on prey species (fish)		8.0 Research & Monitoring		Research population parameters and/or monitor status		L

Sagebrush vole		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Unknown		Unknown		Southern Rocky Mountains	<input checked="" type="checkbox"/>	
						Utah High Plateau		
						Utah-Wyoming Rocky Mountains		
						Wyoming Basin		
General Threat		Specific Threat		General Conservation Action		Specific Conservation Action		Priority
07.3 Other Ecosystem Modifications		Habitat degradation from variety of sources		2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic		H
13.4 Population status unknown		Lack of data on population status		8.0 Research & Monitoring		Research population parameters and/or monitor status		H
13.5 Population trend unknown		Lack of data on population trend		8.0 Research & Monitoring		Research population parameters and/or monitor status		H
02.3 Livestock Farming & Ranching		Reduced grass/forb diversity		2.3 Habitat & Natural Process Restoration		Re-seed native species		M
02.3 Livestock Farming & Ranching		Reduced grass/forb diversity		5.3 Private Sector Standards & Codes		Implement Best Management Practices for livestock grazing		M
03.1 Oil & Gas Drilling		Oil & gas development, pipelines, and infrastructure		5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		M
07.1 Fire & Fire Suppression		Altered fire regime and juniper encroachment		2.3 Habitat & Natural Process Restoration		Restore natural fire regime		M
07.3 Other Ecosystem Modifications		Habitat degradation from variety of sources		2.3 Habitat & Natural Process Restoration		Restore native habitat, including restoration of understory species, sagebrush, and riparian vegetation, reseedling of native species, and maintenance of appropriate patch size and habitat mosaic		M

Table 7 - Continued.

Snowshoe hare		Population Status and Trend		Distribution	Type	Habitat	Primary
	Medium	X	Unknown	X	Southern Rocky Mountains	P	Lodgepole Pine <input checked="" type="checkbox"/>
<i>Lepus americanus</i>							Riparian Woodlands and Shrublands <input checked="" type="checkbox"/>
Tier 2	Mammals						Spruce - Fir <input checked="" type="checkbox"/>
							Wetlands <input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
05.3 Logging & Wood Harvesting	Clearcutting	8.0 Research & Monitoring		Research species/habitat response to management	M		
05.3 Logging & Wood Harvesting	Clearcutting and even-aged forest management	2.1 Site/Area Management		Implement compatible forest management	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring		Conduct primary research on species and habitat responses to changing climate	M		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	M		
06.1 Recreational Activities	Unregulated backcountry winter recreation	8.0 Research & Monitoring		Research species/habitat response to management	L		
08.2 Problematic Native Species	Habitat loss / degradation due to beetle kill	8.0 Research & Monitoring		Research species/habitat response to management	L		
Swift fox		Population Status and Trend		Distribution	Type	Habitat	Primary
	Medium	D	Stable	D	Central Shortgrass Prairie	P	Shortgrass Prairie <input checked="" type="checkbox"/>
<i>Vulpes velox</i>					Front Range	O	Agriculture <input type="checkbox"/>
Tier 2	Mammals						Conservation Reserve Program <input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation, urban development, landscaping, etc.	H		
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration		Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences)	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	6.4 Conservation Payments		Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)	M		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	L		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	L		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	L		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	L		
08.4 Pathogens	Loss of prairie dog colonies due to sylvatic plague	8.0 Research & Monitoring		Research species/habitat response to plague management	L		

Table 7 - Continued.

White-tailed jackrabbit		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Medium	X	Unknown	X	Central Shortgrass Prairie	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
<i>Lepus townsendii</i>						Front Range	p	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
Tier 2	Mammals					Southern Rocky Mountains	p	Shortgrass Prairie	<input checked="" type="checkbox"/>
						Utah High Plateau	p	Desert Shrub	<input type="checkbox"/>
						Utah-Wyoming Rocky Mountains	p	Greasewood	<input type="checkbox"/>
						Wyoming Basin	P	Oak and Mixed Mountain	<input type="checkbox"/>
						Colorado Plateau	O	Shrublands	<input type="checkbox"/>
								Sagebrush	<input type="checkbox"/>
								Saltbush	<input type="checkbox"/>
								Sandsage	<input type="checkbox"/>
								Upland Shrub	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
14.5 Competition	Competition	2.3 Habitat & Natural Process Restoration	Monitor/control competition with other species	M

Tier 2 Mollusks

Cloche ancylid		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Declining	X	Front Range	P	Lakes	<input checked="" type="checkbox"/>
<i>Ferrissia walkeri</i>						Utah High Plateau	P	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
Tier 2	Mollusks							Reservoirs and Shorelines	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.2 Critical life history/habitat components unknown	Habitat affinities unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
13.4 Population status unknown	Referenced in literature, but current populations are unknown. Colorado surveys conducted from 2001-2004 did not record this species.	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	M
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native invertebrates using integrated pest management techniques for aquatic habitats	M

Table 7 - Continued.

Cockerell

Population Status and Trend		Distribution	Type	Habitat	Primary	
Low	X	Declining	X	Southern Rocky Mountains	P	Lakes <input checked="" type="checkbox"/>
						Mountain Streams <input type="checkbox"/>
						Wetlands <input type="checkbox"/>

Promenetus umbilicatellus

Tier 2 Mollusks

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation, woody encroachment, chaining sagebrush, seral stage imbalance, etc.)	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	H
13.4 Population status unknown	Referenced in literature, but current populations are unknown. Colorado surveys conducted from 2001-2004 did not record this species.	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	2.3 Habitat & Natural Process Restoration	Maintain and restore natural ponds and small mountain lakes	M
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native invertebrates using integrated pest management techniques for aquatic habitats	M
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	3.1 Species Management	Develop collaborative management agreements	M
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	8.0 Research & Monitoring	Research population parameters and/or monitor status	M

Cylindrical papershell

Population Status and Trend		Distribution	Type	Habitat	Primary	
Low	D	Declining	D	Central Shortgrass Prairie	P	Eastern Plains Streams <input checked="" type="checkbox"/>
				Front Range	O	Lakes <input checked="" type="checkbox"/>
				Southern Rocky Mountains	O	

Anodontoides ferussacianus

Tier 2 Mollusks

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Nutrient loads (runoff from agricultural activities)	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	H
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area)	2.3 Habitat & Natural Process Restoration	Restore riparian vegetation	H
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
14.1 Scarcity (leading to inbreeding depression)	Known from only 2 locations in Colorado. Colorado surveys conducted from 1996-2004 recorded this species at Valmont Lake and the St. Vrain Creek in Boulder County.	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore native prairie	M
02.3 Livestock Farming & Ranching	Decreased water quality (nutrient load from cattle)	2.1 Site/Area Management	Implement compatible grazing practices	M
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native invertebrates using integrated pest management techniques for aquatic habitats	M

Table 7 - Continued.

Fragil ancylid		Population Status and Trend		Distribution	Type	Habitat	Primary
		Low	X Declining D	Central Shortgrass Prairie	P	Eastern Plains Rivers	<input checked="" type="checkbox"/>
				Wyoming Basin	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
<i>Ferrissia fragilis</i>				Front Range	O	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
Tier 2	Mollusks					Lakes	<input type="checkbox"/>
						Reservoirs and Shorelines	<input type="checkbox"/>
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		H
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation, woody encroachment, chaining sagebrush, seral stage imbalance, etc.)			2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition		H
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation, woody encroachment, chaining sagebrush, seral stage imbalance, etc.)			2.3 Habitat & Natural Process Restoration	Restore riparian vegetation		H
13.1 Complete distribution in Colorado unknown	Known from only 3 locations in Colorado. Colorado surveys conducted from 2001-2004 recorded this species at Bear Canyon Creek and Sliver Lake Ditch in Boulder County, and Banner Lake No. 5 in Weld County, Colorado.			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		H
14.1 Scarcity (leading to inbreeding depression)	Scarcity			8.0 Research & Monitoring	Research population parameters and/or monitor status		H
07.2 Dams & Water Management/Use	Altered native vegetation (riparian area deforestation, woody encroachment, chaining sagebrush, seral stage imbalance, etc.)			2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions		M
07.2 Dams & Water Management/Use	Decreased water quality			2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements		M
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals			2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime		M
Hot Springs physa		Population Status and Trend		Distribution	Type	Habitat	Primary
		Low	X Unknown X	Southern Rocky Mountains	P	Hot Springs	<input checked="" type="checkbox"/>
<i>Physa cupreonitens</i>							
Tier 2	Mollusks						
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
06.3 Work & Other Activities	Proximal non-recreation disturbance			4.3 Awareness & Communications	Implement landowner outreach/education program		H
13.3 Genetic relationship with other species and/or subspecies unknown	Clarification of taxonomy is needed			8.0 Research & Monitoring	Research genetic relation to other (sub)species		H
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution) physid snails have been reported from only 6 hot springs in Colorado			8.0 Research & Monitoring	Research population parameters and/or monitor status		H
08.1 Invasive Non-Native/Alien Species	Invasive animals			2.2 Invasive/Problematic Species Control	Control non-native invertebrates using integrated pest management techniques for aquatic habitats		M
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring	Research population parameters and/or monitor status		M

Table 7 - Continued.

Pondhorn		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	D	Declining	D	Central Shortgrass Prairie	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
						Lakes	<input checked="" type="checkbox"/>
<i>Uniomerus tetralasmus</i>							
Tier 2 Mollusks							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration		Restore native prairie	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Restore or maintain suitable hydrological regime	H		
09.3 Agricultural & Forestry Effluents	Nutrient loads (runoff from agricultural activities)	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown. Colorado surveys conducted from 1996-2002 recorded this species at 1 location, Queens (Neeskah) Reservoir, Kiowa County.	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H		
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	8.0 Research & Monitoring		Research population parameters and/or monitor status	H		
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control		Control non-native invertebrates using integrated pest management techniques for aquatic habitats	M		
Rocky Mountain capshell		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	D	Unknown	X	Southern Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>
						Mountain Streams	<input type="checkbox"/>
<i>Acroloxus coloradensis</i>							
Tier 2 Mollusks							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control		Control non-native invertebrates using integrated pest management techniques for aquatic habitats	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H		
13.4 Population status unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	H		
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	8.0 Research & Monitoring		Research population parameters and/or monitor status	H		
Sharp sprite		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	X	Declining	X	Southern Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>
				Wyoming Basin	O	Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>
						Mountain Streams	<input type="checkbox"/>
						Wetlands	<input type="checkbox"/>
<i>Promenetus exacuouus</i>							
Tier 2 Mollusks							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	2.3 Habitat & Natural Process Restoration		Maintain and Restore natural ponds and small mountain lakes	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown (reported only from 11 Colorado locations, Colorado surveys conducted from 2001-2004 did not record this species.	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H		
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status	H		
14.1 Scarcity (leading to inbreeding depression)	Scarcity	8.0 Research & Monitoring		Research population parameters and/or monitor status	H		
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control		Control non-native invertebrates using integrated pest management techniques for aquatic habitats	M		

Table 7 - Continued.

Utah physa		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Unknown	X	Front Range	P	Lakes	<input checked="" type="checkbox"/>
						Utah High Plateau	P	Transition Streams	<input checked="" type="checkbox"/>
<i>Physa gyrina utahensis</i>		The taxonomy of the North American Physidae both at the generic and specific level needs attention and revision. Validity of this species requires genetic verification.							
Tier 2	Mollusks								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
13.3 Genetic relationship with other species and/or subspecies unknown	Clarification of taxonomy is needed	8.0 Research & Monitoring		Research genetic relation to other (sub)species		H			
13.4 Population status unknown	Referenced in literature, but current populations are unknown. Colorado surveys conducted from 2001-2004 did not record this species.	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		H			
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status		H			
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	8.0 Research & Monitoring		Research population parameters and/or monitor status		H			
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Maintain linkages and connectivity		M			
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control		Control non-native invertebrates using integrated pest management techniques for aquatic habitats		M			

Tier 2 Reptiles

Blacknecked gartersnake		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Low	X	Unknown	X	Central Shortgrass Prairie	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
						Colorado Plateau	O	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
								Eastern Plains Rivers	<input checked="" type="checkbox"/>
								Eastern Plains Streams	<input checked="" type="checkbox"/>
								Desert Shrub	<input type="checkbox"/>
								Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
								Pinyon - Juniper	<input type="checkbox"/>
								Shortgrass Prairie	<input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
14.1 Scarcity (leading to inbreeding depression)	Scarcity	8.0 Research & Monitoring		Research population parameters and/or monitor status		M			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic		L			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations		Promote consideration of biodiversity issues in transportation and land use planning processes		L			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects, urban development, landscaping, etc.		L			
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production		L			
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status		L			

Table 7 - Continued.

California kingsnake		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	X	Unknown	X	Central Shortgrass Prairie	P	Desert Shrub	<input checked="" type="checkbox"/>
				Colorado Plateau	P	Mixed and Tallgrass Prairies	<input type="checkbox"/>
						Playas	<input type="checkbox"/>
<i>Lampropeltis californiae</i>							
Tier 2 Reptiles							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
04.1 Roads & Railroads	Collision (e.g., auto)	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	L		

Common gartersnake		Population Status and Trend		Distribution	Type	Habitat	Primary
Medium	X	Declining	X	Front Range	P	Eastern Plains Rivers	<input checked="" type="checkbox"/>
				Central Shortgrass Prairie	O	Eastern Plains Streams	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	O	Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
						Wetlands	<input checked="" type="checkbox"/>
<i>Thamnophis sirtalis</i>							
Tier 2 Reptiles							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration		Maintain appropriate patch size and habitat mosaic	M		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations		Promote zoning that concentrates use and protects habitat	M		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M		
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.2 Policies & Regulations		Monitor water quality standards	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M		

Desert nightsnake		Population Status and Trend		Distribution	Type	Habitat	Primary
Low	X	Unknown	X	Central Shortgrass Prairie	P	Desert Shrub	<input checked="" type="checkbox"/>
				Colorado Plateau	P	Greasewood	<input checked="" type="checkbox"/>
				Southern Rocky Mountains		Pinyon - Juniper	<input checked="" type="checkbox"/>
				Utah High Plateau		Eastern Plains Streams	<input type="checkbox"/>
						Sagebrush	<input type="checkbox"/>
						Shortgrass Prairie	<input type="checkbox"/>
<i>Hypsiglena chlorophaea</i>							
Tier 2 Reptiles							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	M		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations		Promote consideration of biodiversity issues in transportation and land use planning processes	L		

Desert spiny lizard		Population Status and Trend		Distribution	Type	Habitat	Primary
Unknown		Unknown		Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
<i>Sceloporus magister</i>							
Tier 2 Reptiles							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status	M		
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring		Research population parameters and/or monitor status	M		

Table 7 - Continued.

Long-nosed leopard lizard		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Unknown	X	Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
								Greasewood	<input checked="" type="checkbox"/>
								Pinyon - Juniper	<input checked="" type="checkbox"/>
								Sagebrush	<input checked="" type="checkbox"/>
								Saltbush	<input checked="" type="checkbox"/>
<i>Gambelia wislizenii</i>									
Tier 2	Reptiles								
General Threat	Specific Threat	Population Status and Trend		Distribution	Type	Habitat	Primary		
08.1 Invasive Non-Native/Alien Species	Invasive plants - cheatgrass			2.3 Habitat & Natural Process Restoration		Restore native habitat using site-specific techniques and context	M		
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring		Research population parameters and/or monitor status	M		
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring		Research population parameters and/or monitor status	M		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.2 Policies & Regulations		Promote consideration of biodiversity issues in transportation and land use planning processes	L		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	L		
Long-nosed snake		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Low	X	Unknown	X	Central Shortgrass Prairie	P	Sandsage	<input checked="" type="checkbox"/>
								Shortgrass Prairie	<input checked="" type="checkbox"/>
								Conservation Reserve Program	<input type="checkbox"/>
								Eastern Plains Rivers	<input type="checkbox"/>
								Sagebrush	<input type="checkbox"/>
<i>Rhinocheilus lecontei</i>									
Tier 2	Reptiles								
General Threat	Specific Threat	Population Status and Trend		Distribution	Type	Habitat	Primary		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M		
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring		Research population parameters and/or monitor status	M		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	L		
Midget faded rattlesnake		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Unknown	X	Colorado Plateau	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Desert Shrub	<input checked="" type="checkbox"/>
						Utah High Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
								Greasewood	<input type="checkbox"/>
								Sagebrush	<input type="checkbox"/>
								Saltbush	<input type="checkbox"/>
<i>Crotalus oreganus concolor</i>									
Tier 2	Reptiles								
General Threat	Specific Threat	Population Status and Trend		Distribution	Type	Habitat	Primary		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M		
06.1 Recreational Activities	Off-road and trail development and use			2.1 Site/Area Management		Manage public use to be compatible with biodiversity	M		
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Illegal take			5.4 Compliance & Enforcement		Enforce hunting, fishing, collecting regulations	L		
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring		Research population parameters and/or monitor status	L		
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring		Research population parameters and/or monitor status	L		

Table 7 - Continued.

**New Mexico
threadsnake**

Population Status	and Trend	Distribution	Type	Habitat	Primary
Unknown	X Unknown	Central Shortgrass Prairie	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
	X			Shortgrass Prairie	<input checked="" type="checkbox"/>
				Eastern Plains Streams	<input type="checkbox"/>

Rena dissectus

Tier 2 Reptiles

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M

**Round-tailed horned
lizard**

Population Status	and Trend	Distribution	Type	Habitat	Primary
Unknown	X Unknown	Central Shortgrass Prairie	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
	X			Shortgrass Prairie	<input checked="" type="checkbox"/>

Phrynosoma modestum

Tier 2 Reptiles

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
09.3 Agricultural & Forestry Effluents	Poisoning (fire ant insecticides)	4.3 Awareness & Communications	Implement landowner outreach/education program	M
14.1 Scarcity (leading to inbreeding depression)	Scarcity (Colorado occurrences known only from two sites apparently disjunct from core range)	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Illegal take	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	L
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	L
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

**Smith's black-headed
snake**

Population Status	and Trend	Distribution	Type	Habitat	Primary
Unknown	X Unknown	Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
	X	Southern Rocky Mountains	O	Greasewood	<input checked="" type="checkbox"/>
				Pinyon - Juniper	<input checked="" type="checkbox"/>
				Sagebrush	<input checked="" type="checkbox"/>
				Saltbush	<input checked="" type="checkbox"/>
				Conservation Reserve Program	<input type="checkbox"/>

Tantilla horbartsmithi

Tier 2 Reptiles

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	M
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
13.5 Population trend unknown	Lack of data on population trend	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
04.1 Roads & Railroads	Collision (e.g., auto)	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L

Table 7 - Continued.

Texas horned lizard		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Medium	D	Stable	X	Central Shortgrass Prairie	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
							Shortgrass Prairie	<input checked="" type="checkbox"/>
							Conservation Reserve Program	<input type="checkbox"/>
<i>Phrynosoma cornutum</i>								
Tier 2 Reptiles								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	H		
09.3 Agricultural & Forestry Effluents	Poisoning (fire ant insecticides)			4.3 Awareness & Communications	Implement landowner outreach/education program	M		
04.1 Roads & Railroads	Collision (e.g., auto)			4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L		
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Illegal take			5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	L		
Utah milksnake		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Unknown		Unknown	Central Shortgrass Prairie	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>	
				Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>	
				Front Range	P	Sandsage	<input checked="" type="checkbox"/>	
				Southern Rocky Mountains	O	Shortgrass Prairie	<input checked="" type="checkbox"/>	
				Wyoming Basin	O			
<i>Lampropeltis triangulum taylori</i>								
Tier 2 Reptiles								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc.	M		
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring	Research population parameters and/or monitor status	M		
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring	Research population parameters and/or monitor status	M		
Yellow mud turtle		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	X	Unknown	X	Central Shortgrass Prairie	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
							Lakes	<input checked="" type="checkbox"/>
							Sandsage	<input checked="" type="checkbox"/>
							Wetlands	<input type="checkbox"/>
<i>Kinosternon flavescens</i>								
Tier 2 Reptiles								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M		
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff			2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	M		
13.5 Population trend unknown	Lack of data on population trend			8.0 Research & Monitoring	Research population parameters and/or monitor status	M		

Chapter 6: Threats and Actions for Habitats

Summary of Threats

Of 36¹⁵ terrestrial and aquatic habitats, almost all are affected by residential/commercial development and natural systems modifications (including alteration of hydrological and fire regimes) (Figure 9). Conversion or degradation from incompatible agricultural activities, climate change, and invasive species are affecting more than two-thirds of Colorado's habitat types (Figure 9). All of our seven forest types are impacted by climate change, natural systems modifications, and invasive species. Of seven shrubland types, all are impacted by residential/commercial development and incompatible agricultural practices. All three grassland types and all three riparian/wetland types are affected by residential/commercial development, incompatible agricultural practices, natural system modifications, invasives, and climate change. Not surprisingly, the most significant issues for aquatic habitats are urbanization and natural system modification, specifically dams and water management/use (Figure 10). For descriptions of the threats represented in the figures below, refer to Chapter 4 and Table 5.

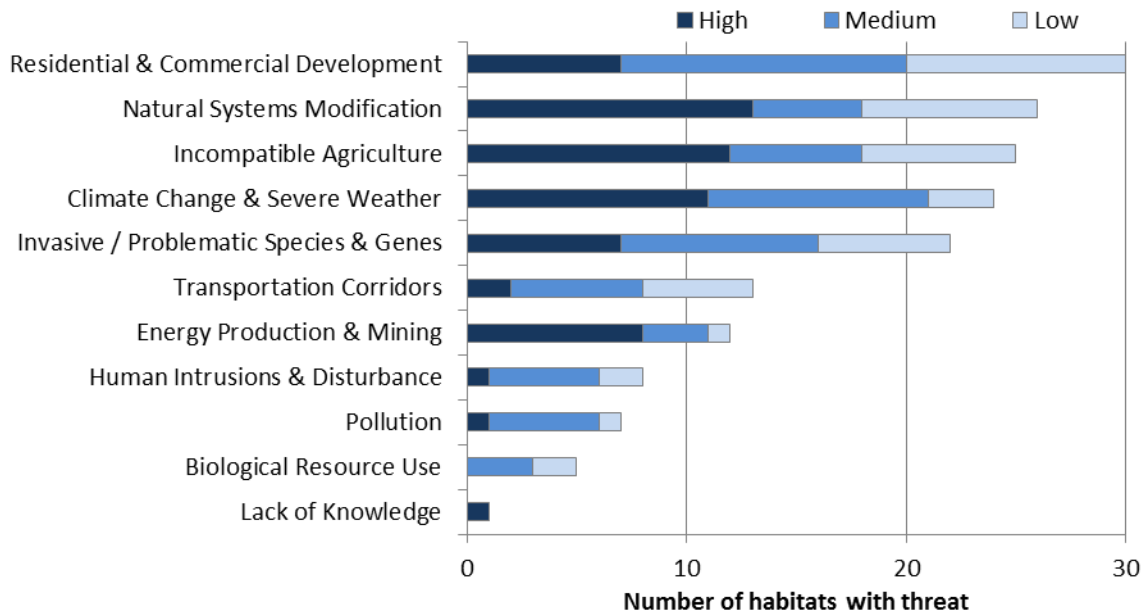


Figure 9. Threats to habitats by priority.

¹⁵ Though the SWAP recognizes some habitat value in reservoirs, creation of these kinds of conditions are not compatible with most of Colorado's native biodiversity; therefore, this habitat is not included in consideration of threats or targeted for conservation action.

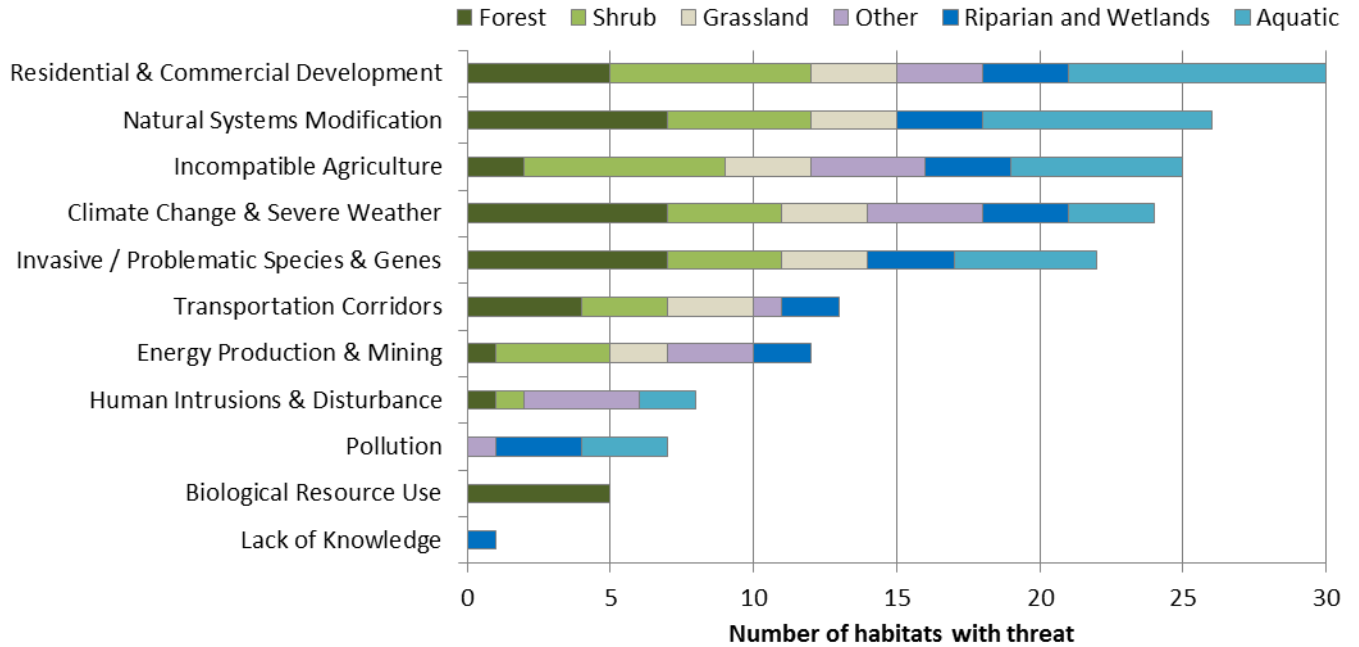


Figure 10. Threats to habitats by habitat type.

Summary Conservation Actions Needed

Habitats are most in need of management and restoration (Figures 11 and 12). All forest, shrubland, grassland, riparian, and wetland habitats, and almost all aquatic habitats, are in need of restoration of specific habitat components and/or ecological processes. Some land uses, such as grazing and logging, can be used as management tools to help restore the species composition and structure of habitats, as well as to mimic disturbance regimes (fires and floods, for example) that are needed to maintain certain habitat types. Land and resource protection and management, and research are also significant needs, as are control of non-natives and implementation of compatible practices by private enterprise. Development and implementation of Best Management Practices for energy, agriculture, transportation, urban development, forestry, and water management industries could make significant contributions to improving habitat health. For descriptions of the conservation actions referenced in the figures below, refer to Chapter 4 and Table 6.

Colorado's 2015 State Wildlife Action Plan

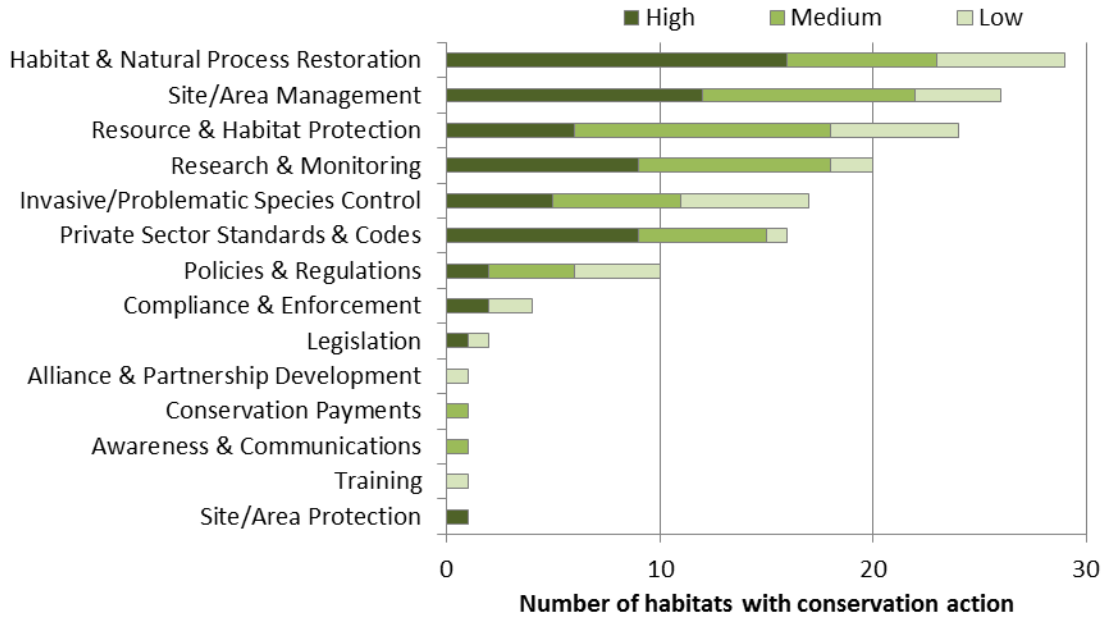


Figure 11. Conservation actions needed for habitats by priority.

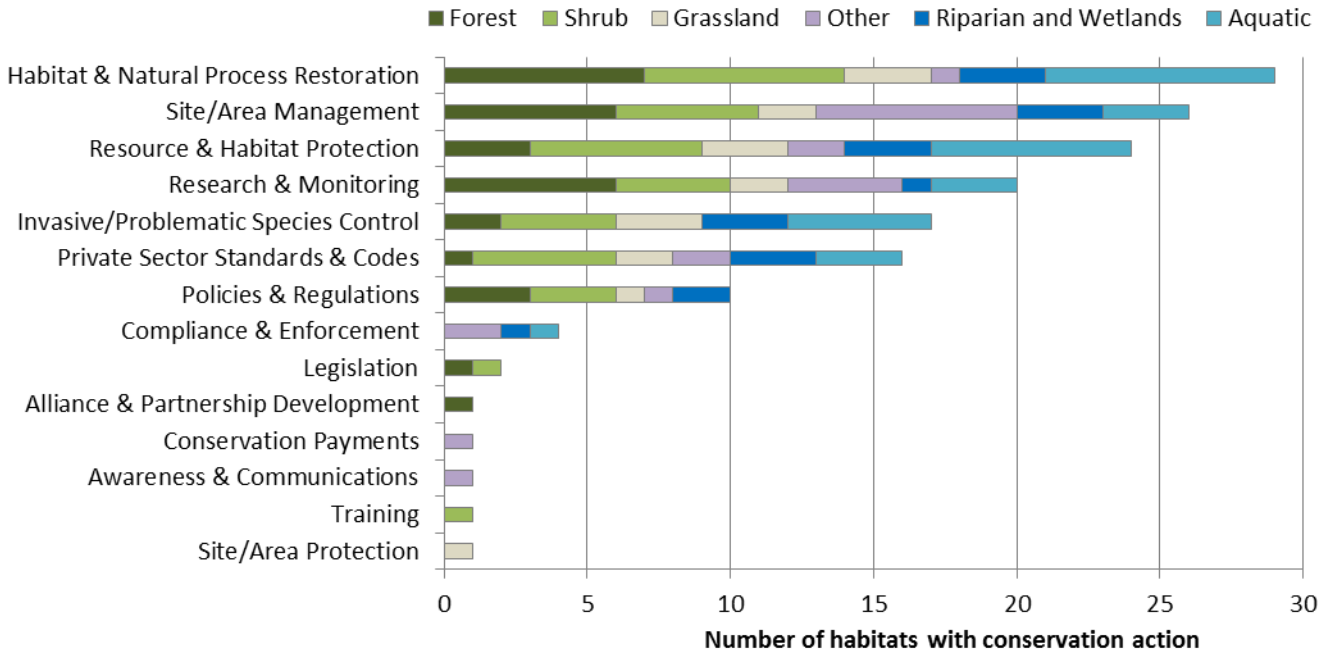


Figure 12. Conservation actions needed for habitats by habitat type.

Threats and Actions Narratives for Habitats

For the purposes of the SWAP, the most crucial threats and highest priority conservation actions for habitats are briefly summarized in the following narratives. Habitats are grouped by type (e.g., forests, shrublands) and then listed alphabetically. Table 8 includes associated SGCN, threats, and prioritized conservation actions for each habitat. In order to avoid duplicating the content of Table 8 in Appendices A and B (rare plants and non-mollusk invertebrates), those taxa are included here, as is one plant-specific habitat (Barrens). See Appendix E for a key to the distribution field in Table 8.

FORESTS AND WOODLANDS

Aspen

Threats

1 Residential & Commercial Development

Aspen forests are threatened to some extent by exurban development, or development associated with recreation areas, primarily in the southwestern portion of the state, and at the lower end of the elevation range occupied by this habitat (below 8,500 ft.).

2 Incompatible Agriculture

Threats from agricultural activities are primarily due to browsing by range cattle, which may change both aspen stand structure and understory composition.

4 Transportation Corridors

Secondary roads and utility corridors are a typical coincident impact of exurban and recreational development and contribute to habitat fragmentation.

5 Biological Resource Use

Potential threats include recreational use (e.g., firewood cutting and bark carving) and harvesting of wood products. Aspen is one of the few tree species which has seen increased harvest levels in the past several decades (Morgan et al. 2006), especially in southwest Colorado. Recreational use, hunting, and mining activity are minor sources of disturbance to aspen habitat, as is contamination from tailings and other mining practices.

7 Natural System Modifications

Aspen forests are generally dependent on periodic fire to remove conifers and permit aspen regeneration from root sprouting. Fire suppression has changed the extent and availability of

patches suitable for aspen colonization (CSFS 2005), with a consequent reduction in forage and habitat for dependent species. In addition, the occurrence of Sudden Aspen Decline (SAD) has decreased the abundance of aspen in some areas, which may concentrate ungulate use in remaining patches and further decrease the ability of these habitats to regenerate (Keane et al. 2002).

8 Invasives, Problematic Native Species, & Pathogens

Browsing by native herbivores such as elk can be a significant contributor to changes in stand structure and diversity.

11 Climate Change & Severe Weather

Aspen stands in warm, dry conditions at lower elevations are more threatened by episodic decline, which appears to be tied to drought stress (Rehfeldt et al. 2009). Projected increases in temperature throughout the range of aspen habitat in Colorado are likely to have the greatest impact on these stands, while stands at higher, cooler and wetter elevations are more likely to persist.

Information Needs

Landscape scale analysis of aspen condition class is needed to ascertain appropriate level of heterogeneity and resiliency.

Conservation Actions

Protect privately owned aspen stands through education and conservation easements to limit permanent forest type conversion. Grazing education (both domestic and wildlife) is needed to help promote aspen regeneration through proper grazing management. Reduction in stocking rates of domestic livestock and reduction of native ungulate herds will aid in aspen regeneration. Fencing and hunting in heavily used aspen stands to reduce or exclude herbivory will help regenerate aspen stands. Conduct aspen management education and programs to promote aspen stand management to setback aspen successional stages. Promote the use of characteristic wildfire and prescribed fire to help encourage aspen regeneration and colonization. Promote the use of appropriate silvicultural practices in appropriate stand conditions to help with stand level heterogeneity and stand resiliency. Promote landscape scale analysis of aspen condition class to ascertain appropriate level of heterogeneity and resiliency. Prioritize lower elevation aspen protection and management through education, grant funding and conservation easements.

Lodgepole

Threats

1 Residential & Commercial Development

Development of exurban or recreational areas is a minor source of disturbance and fragmentation in lodgepole forests.

4 Transportation Corridors

Roads and utility corridors associated with exurban or recreational development are a source of fragmentation in lodgepole habitats.

5 Biological Resource Use

Timber harvest in Colorado's lodgepole forests has declined significantly since the late 19th century, but a recent increase in the use of beetle-kill wood has maintained a small market for this species. Wood harvest activities are a minor source of disturbance in this habitat type, but extensive salvage logging and thinning may have local impacts.

7 Natural System Modifications

Fire suppression effects in lodgepole pine forests are evident at a landscape level in an overall lack of variety in successional stages. Individual lodgepole stands may not be outside the natural range of variation, but at a landscape level fire suppression has probably led to larger, denser, more homogenous patches that are more favorable for large fire and heavy infestations of mountain pine beetle (Keane et al. 2002).

8 Invasives, Problematic Native Species, & Pathogens

The scope and visibility of the most recent mountain pine beetle outbreak in lodgepole habitat has complicated policy and management responses to the extensive mortality. There is uneasiness about whether the outbreak is a climate-change driven crisis (e.g., "a major threat to regional economics and public safety," USFS Medicine Bow-Routt National Forest website) or merely an example within the natural range of variation for such outbreaks, or both. The current outbreak appears to be subsiding, leaving the potential for large fires with extreme behavior to occur in the killed forests (Kaufmann et al. 2008). Warmer winters and drought can facilitate mountain pine beetle outbreaks, but mortality is already widespread, so the population of host trees has been greatly reduced. Although large, intact patches of lodgepole forest persist in Colorado, this may change as the effects of extensive mountain pine beetle mortality and increased fire extent and frequency reshape the lodgepole matrix. In combination with climate change, the aftermath of the recent severe outbreak of mountain pine beetle is likely to lead to forms of lodgepole forest that are different from those seen in past, pre-outbreak years.

11 Climate Change & Severe Weather

Our climate change vulnerability analysis (Appendix F) indicated that lodgepole pine forests in Colorado are moderately vulnerable to the effects of climate change by mid-century. The vulnerability of this habitat to forest disturbances affected by climate conditions (mountain pine beetle and fire) and the fact that it is at the southern edge of its distribution in Colorado are primary factors contributing to this assessment result.

Information Needs

Promote landscape scale analysis of lodgepole pine condition class to ascertain appropriate level of heterogeneity and resiliency.

Conservation Actions

Limit the footprint of permanent development within lodgepole pine forests through education and conservation easement. Additionally, provide education on the threat of wildfire to communities and landowners, along with realistic, outcome-based approaches to reduce wildfire risk. Timber harvesting within lodgepole pine at the appropriate sites and scale is needed to maintain pure lodgepole pine stands for lodgepole obligate wildlife species. Continuing to increase stand heterogeneity to reduce large, continuous even-aged stands will help reduce risk of uncharacteristic wildfire and large scale pine beetle outbreaks in the future. Promoting management to mimic natural range of forest disturbances to increase stand heterogeneity may reduce potential negative impacts from management intervention.

Mixed Conifer

Threats

1 Residential & Commercial Development

Exurban development and recreational area development are a threat to mixed conifer forests along the Front Range and I-70 corridor in mountain areas.

4 Transportation Corridors

Roads and utility corridors are a source of disturbance and fragmentation in mixed conifer forests statewide, but these stands naturally occur in smaller patches than some other forest types, so threats are low.

5 Biological Resource Use

A number of tree species in mixed conifer are suitable for timber harvest, so logging is a source of disturbance in these forests. Threats from livestock grazing and human disturbances (e.g., hunting, recreational activities) are minimal for mixed conifer forests. Mining and mine tailings are a small source of disturbance in mixed conifer forests.

7 Natural System Modifications

In areas adjacent to development, mixed conifer stands may be part of the wildland-urban interface, where they are most likely to be threatened by the effects of by inappropriate management intervention or fire suppression. The absence of a natural fire regime in these forests has resulted in increased tree density and the buildup of duff and litter, which may increase the severity of fire when it does occur.

8 Invasives, Problematic Native Species, & Pathogens

Stands in the southern part of Colorado have been impacted by the western spruce budworm and drought. Budworm outbreaks are part of a natural cycle in mixed conifer forests, but may be intensified by increasing drought frequency and the generally higher temperatures projected in coming decades.

11 Climate Change & Severe Weather

The diversity of species within mixed conifer forests may increase its flexibility in the face of climate change. Changing climate conditions are likely to alter the relative dominance of overstory species, overall species composition and relative cover, primarily through the action of fire, insect outbreak, and drought. Drought and disturbance tolerant species will be favored over drought vulnerable species. Species that are infrequent and have a narrow bioclimatic envelope (e.g., blue spruce) are likely to decline or move up in elevation. Abundant species that have a wide bioclimatic envelope (e.g., aspen) are likely to increase. Outcomes for particular stands will depend on current composition and location. Current stands of warm, dry mixed conifer below 8,500 ft. may be at higher risk or may convert to pure ponderosa pine stands as future precipitation scenarios favor rain rather than snow. Upward migration into new areas may be possible.

Information Needs

Promote landscape scale analysis of mixed conifer condition class to ascertain appropriate level of heterogeneity and resiliency. Better definition of mixed conifer and understanding historic range of variability along with the ecological drivers may aid in the conservation of this habitat type.

Conservation Actions

Limit the footprint of permanent development in mixed conifer forests through education and conservation easement. Additionally, provide education on the threat of wildfire to communities and landowners, along with realistic, outcome-based approaches to reduce wildfire risk. Promoting management actions that mimic the natural range of forest disturbances to increase stand heterogeneity may reduce potential negative impacts from management intervention. Increasing landscape level heterogeneity may reduce size and intensity of wildfires or disease outbreaks.

Pinyon-Juniper

Threats

1 Residential & Commercial Development

Ongoing but limited threats from urban, exurban, and commercial development are primarily in the south central and southwestern portions of Colorado, where towns, roads, and utility corridors are often in close proximity to pinyon-juniper woodlands. As with other habitats in the wildland-urban interface, areas near developed areas are most likely to be threatened by the effects of fire suppression, while more remote areas are generally in good condition.

2 Incompatible Agriculture

Livestock grazing has degraded the understory grasses of some stands, and invasive cheatgrass has become established in some areas. Tree removal by chaining is a minor source of disturbance within these woodlands, but dramatically changes the habitat where it has occurred.

3 Energy Production & Mining

Oil and gas development, with associated roads, pipeline corridors, and infrastructure, is an ongoing source of disturbance and fragmentation for most pinyon-juniper habitats.

6 Human Intrusions & Disturbance

Military training activities are a source of disturbance to this habitat at Fort Carson and Pinyon Canyon Maneuver Site. Increased recreational use of pinyon-juniper forests is also of concern in areas adjacent to growing urban centers in the southeast and southwest portions of the state. These lower elevations often remain accessible year-round and are increasingly utilized for horseback riding, hiking, ATV's, bicycling, and other recreational activities that degrade habitat and disturb wildlife during vulnerable periods.

7 Natural System Modifications

In areas adjacent to development, pinyon-juniper stands may be part of the wildland-urban interface, where they are most likely to be threatened by the effects of by inappropriate management intervention or fire suppression. In addition, efforts to secure residential and commercial developments from the threat of wildfire often result in the severe alteration or complete removal of pinyon-juniper stands within the designated wildland-urban interface. These activities interrupt the natural seral progression of the impacted stands and may degrade the usefulness of the remaining habitat for wildlife.

8 Invasives, Problematic Native Species, & Pathogens

Pinyon are susceptible to the fungal pathogen *Leptographium wageneri* var. *wageneri*, which causes black stain root disease, and to infestations of the pinyon ips bark beetle (*Ips*

confusus) (Kearns and Jacobi 2005), which has caused extensive mortality in pinyon-juniper habitats in southern Colorado. Extended drought can increase the frequency and intensity of both insect outbreaks and wildfire. Some recently burned pinyon-juniper habitats do not appear to be regenerating (e.g., burns at Mesa Verde), perhaps due to a lack of suitable precipitation conditions and few available seed sources (Floyd et al. 2000; Barger et al. 2009).

11 Climate Change & Severe Weather

Variable disturbance and site conditions across the distribution of this ecosystem have resulted in a dynamic mosaic of interconnected communities and successional stages across the landscape that can be naturally resilient. Since the last major glacial period, the distribution and relative abundance of pinyon and juniper has fluctuated dynamically with changing climatic conditions. Warming conditions during the past two centuries, together with changing fire regime, livestock grazing, and atmospheric pollution, increased the ability of this ecosystem to expand into neighboring communities, at both higher and lower elevations (Tausch 1999). However, precipitation and temperature patterns are projected to change in a direction that is less favorable for pinyon, so that juniper may become more dominant, and these habitats may be unable to persist or expand in their current form.

Our climate change vulnerability analysis (Appendix F) indicated that pinyon-juniper woodlands in Colorado are moderately vulnerable to the effects of climate change by mid-century. The vulnerability of this habitat to stressors affected by climate conditions (Ips beetle, drought, and fire) and widespread effects on anthropogenic disturbance are primary factors contributing to this assessment result.

Information Needs

An improved understanding of the potential impacts of climate change and options for adaptation strategies is needed.

Conservation Actions

Less than 1% of the Pinyon-Juniper woodlands in Colorado are directly managed by Colorado Parks & Wildlife (unpublished CPW GIS analysis). On these properties, our goal will be to maintain a diversity of age classes with a focus on maintaining stands of old growth (>250 years) trees. Mid and some late-seral stands may be thinned to push succession forward, or removed to reset succession. Tree thinning or removal may also be undertaken to protect infrastructure on State Parks or in adjacent communities. In those areas where past management activities such as fire suppression have facilitated the establishment of young trees into sagebrush parks, treatments may be implemented to remove the encroaching trees and restore the integrity of the sagebrush community. In those habitats where CPW lacks direct administrative oversight, we will work with the managing agency (generally BLM) or private landowner to ensure that a proper balance of age and understory characteristics are maintained across the landscape.

Ponderosa Pine

Threats

1 Residential & Commercial Development

Urban and exurban development are a primary threat to ponderosa pine habitat, especially along the Front Range, but also in other parts of the state. Increasing development has led to an extensive wildland-urban interface in ponderosa habitat (Theobald 2005).

4 Transportation Corridors

Fragmentation of stands in exurban areas due to housing, roads, and utility corridors is likely to continue.

5 Biological Resource Use

Wood harvest activities are a minor source of disturbance in this habitat type, but extensive salvage logging and thinning may have local impacts.

7 Natural System Modifications

Ponderosa forest and woodland historically experienced relatively frequent low intensity fires that controlled the density, age, and structure of stands. With fire suppression, ponderosa has increased into foothills grassland, stands have greatly increased in density, and open ponderosa savanna habitat has decreased. Increased tree density and fuel accumulation has resulted in more severe fires in this habitat, as well as increased occurrence of mountain pine beetle and dwarf mistletoe infestation. The alteration of natural fire regimes through fire suppression is an ongoing threat for ponderosa pine habitat near developed areas.

8 Invasives, Problematic Native Species, & Pathogens

Mountain pine beetle has caused extensive mortality in ponderosa pine habitats throughout Colorado, although the current outbreak appears to be subsiding. Impacts of native grazers or domestic livestock and the spread of invasive grasses could also alter understory structure and composition, with the potential to negatively impact soil stability (Allen et al. 2002).

11 Climate Change & Severe Weather

Climate change may alter fire regimes slightly by affecting the community structure, but fire is not a primary threat for the persistence of this habitat, and may actually be beneficial in some areas if it restores some pre-settlement conditions (Covington and Moore 1994). A projected increase in the frequency of drought conditions is likely to exacerbate both fire and insect outbreaks, and change the structure and composition of ponderosa pine habitats.

Our climate change vulnerability analysis (Appendix F) indicated that ponderosa pine forests and woodlands in Colorado are moderately vulnerable to the effects of climate change by mid-century. The exposure of this habitat to warmer temperatures that interact with stressors (mountain pine beetle, drought, and fire) is the primary factor contributing to this assessment result.

Information Needs

Promote landscape scale analysis of ponderosa pine condition class to ascertain appropriate level of heterogeneity and resiliency.

Conservation Actions

Limit the footprint of permanent development in ponderosa pine forests through education and conservation easement. Additionally, provide education on the threat of wildfire to communities and landowners, along with realistic, outcome-based approaches to reduce wildfire risk.

Promoting management to mimic natural range of variation of forest disturbances to increase stand heterogeneity may reduce potential negative impacts from management intervention.

Increasing landscape level heterogeneity may reduce size and intensity of wildfires. Promoting the use of low and mixed severity prescribed fire will increase the pace and efficiency of forest restoration. Increasing the level of funding for management activities on both private and public land will increase the scale of forest restoration in this forest type.

Spruce-Fir

Threats

5 Biological Resource Use

Timber harvest in spruce-fir forests has declined significantly since the late 19th century, but is an ongoing disturbance. Wood harvest activities are a minor source of disturbance in this habitat type, but extensive salvage logging and thinning may have local impacts.

7 Natural System Modifications

Historic natural fire-return intervals in these forests have been on the order of several hundred years, and the tree species are not adapted to more frequent fires. Because natural fire return intervals in these habitats are long, fire suppression has not had widespread effects on the condition of spruce-fir habitat. At a landscape scale, however, age structures of spruce-fir forest are probably somewhat altered from pre-settlement conditions, so that some historically typical patch types may now be under-represented, with unknown consequences for future ecosystem trajectories.

8 Invasives, Problematic Native Species, & Pathogens

These forests are generally not susceptible to increased prevalence of invasive species, but are highly vulnerable to outbreaks of the native pest species, spruce bud worm and spruce beetle, which have caused extensive tree mortality in southwestern Colorado. Insect and disease outbreaks are typically associated with droughts.

11 Climate Change & Severe Weather

Climate change projections indicate an increase in droughts and faster snowmelt, which could increase forest fire frequency and extent within this habitat. It is not known if spruce-fir forests will be able to regenerate under such conditions, especially in lower elevation stands, and there is a potential for a reduction or conversion to other forest types, depending on local site conditions. The lag time of the current treeline position behind climate change is estimated to be 50-100+ years, due to the rarity of recruitment events, the slow growth and frequent setbacks for trees in the ecotone, and competition with already established alpine vegetation (Körner 2012). However, on the basis of historic evidence, treeline can be expected to migrate to higher elevations as temperatures warm, as permitted by local microsite conditions (Smith et al. 2003; Richardson and Friedland 2009; Grafius et al. 2012). The gradual advance of treeline is also likely to depend on precipitation patterns, particularly the balance of snow accumulation and snowmelt (Rocheftort et al. 1994).

Our climate change vulnerability analysis (Appendix F) indicated that spruce-fir forests in Colorado are moderately vulnerable to the effects of climate change by mid-century. The restriction of this habitat to higher elevations and its relatively narrow biophysical envelope, slow-growth, and position near the southern end of its distribution in Colorado are primary factors contributing to this assessment result.

Information Needs

Promote landscape scale analysis of spruce-fir condition class to ascertain appropriate level of heterogeneity and resiliency. Better understanding historic range of variability and the ecological drivers may aid in the conservation of this habitat type.

Conservation Actions

Limit the footprint of permanent development in spruce-fir forests through education and conservation easement. Additionally, provide education on the threat of wildfire to communities and landowners, along with realistic, outcome-based approaches to reduce wildfire risk. Promoting management that mimics the natural range of forest disturbances to increase stand heterogeneity may reduce potential negative impacts from management intervention. Increasing landscape level heterogeneity may reduce size and intensity of wildfires and disease outbreaks.

Subalpine Limber and Bristlecone Pine

Threats

The scope and severity of most potential threats to subalpine limber and bristlecone pine forests are not well known. Minor impacts are likely from recreational area development, roads, mining, and livestock grazing, which are sources of disturbance, fragmentation, and have the potential to alter structure and condition of some stands.

7 Natural System Modifications

Limber and bristlecone pines are long-lived and slow growing, and are able to grow on cold, nutrient-poor acidic sites (Johnson 2001; Fryer 2004). The poor soils of this habitat generally mean that fuel loads are much less than for some other forest types. Subalpine limber and bristlecone habitat have historically experienced a range of fire regimes, from stand-replacing fires occurring at intervals of 300+ years to more frequent low-intensity surface fires at lower elevations. Both species regenerate on areas that have burned within the past few decades (Baker 1992). Many stands may still be within the historic range of variation for fire regime, although fire suppression may affect regeneration rates in some places.

8 Invasives, Problematic Native Species, & Pathogens

Five-needle pines, including limber and bristlecone, are threatened by white pine blister rust (WPBR) infection caused by the introduced fungus *Cronartium ribicola*. Initially detected in Colorado in northern Larimer County, the disease appears to have slowly spread southward in the state, primarily affecting limber pine, but also occurring on bristlecone pine. Because infections of WPBR seriously threaten these slow-growing and long-lived tree species, the disease has the potential to permanently alter the composition of forest ecosystems in the area (Schoettle 2004). The five-needle pine trees are also vulnerable to outbreaks of the mountain pine beetle (*Dendroctonus ponderosae*), although mortality has been limited in comparison with other conifer types (Gibson et al. 2008).

11 Climate Change & Severe Weather

Limber and bristlecone pine habitats are limited in distribution in Colorado, and although these long-lived species have survived past climate change, their slow recruitment and growth may increase their vulnerability to rapid climatic change, especially if future conditions enhance the spread of WPBR.

Information Needs

Promote landscape scale analysis of five needle pines condition class to ascertain appropriate level of heterogeneity and resiliency. Better understanding historic range of variability and the ecological drivers may aid in the conservation of this habitat type.

Conservation Actions

Promote research on five needle pine systems to understand the basic ecological drivers such as disease and fire. Monitor disease outbreaks as they occur to gain a better understanding of scale and mortality level. Education on the basic ecology of this system and wildlife species potentially impacted by natural disease outbreaks is needed.

SHRUBLANDS

Desert Shrub

Threats

The majority of desert shrub habitats in Colorado occur in the low elevation, west-central valleys along the Colorado, Gunnison, Uncompahgre, Rio Grande and Dolores Rivers. In general, these plant communities are some of the most vulnerable in Colorado. Mancos shale formations dominate these valley floors and produce fine textured/highly alkaline soils that are inhospitable to most plants. The native species that do occur in these areas must be highly adapted to survive high summer temperatures, high pH, and low precipitation. Natural disturbance (primarily fire) in these communities is believed to have been rare, with no predictable fire regime due to discontinuous fuels (LANDFIRE 2007). Because of its historic stability, this plant community responds poorly to any soil disturbing activity, and past efforts to reclaim or restore habitat in the desert shrub community have often failed (Blaisdell and Holmgren 1984). General lack of native competition and slow community response to disturbance has made desert shrublands highly vulnerable to the weed infestations that often follow disturbance.

1 Residential & Commercial Development

Threats to desert shrublands from exurban or recreational area development continue at a moderate level.

2 Incompatible Agriculture

Although conversion to cropland is a limited ongoing threat, livestock grazing is an ongoing source of disturbance that alters the species composition of this habitat statewide.

3 Energy Production & Mining

Oil and gas exploration and production pose a limited threat to the desert shrub community, particularly those in the NW and West-Central Valley's. In the San Luis Valley, concentrated solar energy development is a local source of habitat disturbance. Many of the habitats experiencing energy related impacts now are already highly degraded, and the biggest threat may be the further spread of noxious weeds.

4 Transportation & Service Corridors

Roads and utility corridors, including those associated with solar energy development in the San Luis Valley, are an ongoing source of disturbance, and can facilitate the spread of invasive plant species, which have become established in some areas.

8 Invasives, Problematic Native Species, & Pathogens

Perhaps the single greatest threat to desert shrub habitats in Colorado are invasive weeds. Historic overgrazing opened these habitats to a number of non-native annuals such as cheatgrass, annual wheatgrass, halogeton, and Russian thistle. Over time these plants have come to dominate large areas and are difficult, if not impossible to eradicate. In many cases, livestock grazing and destructive recreational practices (e.g., ATVs) are spreading these weeds and suppressing recovery of the native species.

11 Climate Change & Severe Weather

Climate change could prove devastating to this habitat type. If a predicted warmer/drier climate shift does occur, it is believed that most vegetation communities in Colorado will transition to higher elevations and/or latitudes to compensate. However, many plants living in the salt desert shrub community have evolved over eons to thrive in soils found only in low elevation river valleys. It is questionable whether many of these species could make an abrupt transition to the more sandy/neutral ph soils that dominate much of the next elevation gradient. Higher temperatures and prolonged drought could simply turn these communities into exotic grasslands.

Information Needs

An improved understanding of the potential impacts from climate change is needed.

Conservation Actions

CPW is presently experimenting with potential restoration techniques on the Escalante State Wildlife Area west of Delta. A combination of aerial herbicide application and reseeding will be tested as a way to remove weed competition and restore native salt desert shrub communities. If these techniques prove successful, a collaboration will be formed with the BLM and local landowners that will implement landscape level restoration across broad geographic areas.

Greasewood

Threats

1 Residential & Commercial Development

Threats to the persistence of large, intact greasewood shrublands from exurban or recreational area development continues at a moderate level, primarily in the San Luis Valley.

2 Incompatible Agriculture

Although conversion to cropland is a limited ongoing threat, agricultural activity has an indirect effect on greasewood habitat in the San Luis Valley, since groundwater pumping for crops is a serious threat to the high water table that maintains these saline shrublands. Runoff of fertilizer and pesticide from adjacent agricultural areas is also a potential threat. Although greasewood is both unpalatable and poisonous to most ungulates and highly tolerant of heavy livestock use, livestock grazing is an ongoing source of disturbance that alters the understory species composition of this habitat statewide.

8 Invasives, Problematic Native Species, & Pathogens

Overall, greasewood is one of the most resilient shrubs found in Colorado. This species sprouts readily from the root and has a remarkable tolerance to high water tables and saline soils. Unfortunately, the grass/forb community generally associated with greasewood has proven less resilient to human impacts. At this point in time, the understory in many greasewood communities consists of either non-native grasses that can tolerate heavy grazing, or annual weeds such as cheatgrass and Russian thistle.

Information Needs

Improved understanding of the groundwater depth needed to maintain greasewood is a primary research need.

Conservation Actions

CPW is not planning any conservation actions specific to increasing the distribution of greasewood. However, plant communities associated with greasewood shrublands will be part of a more general salt desert shrub restoration effort as described above. The development of weed management plans may be useful in some areas.

Oak and Mixed Mountain Shrub

Threats

1 Residential & Commercial Development

Ongoing but limited threats from urban, exurban, commercial, and energy development are primarily in the southern and western portions of Colorado, where towns and well fields are often in close proximity to oak shrublands. Mixed mountain shrublands are somewhat less impacted by developments, primarily those associated with recreation areas or exurban housing.

2 Incompatible Agriculture

Livestock grazing has degraded the understory grass community of some oak stands, and invasive cheatgrass and knapweed have become established in some areas. Mixed mountain shrublands are less impacted by invasives.

4 Transportation Corridors

Ongoing but limited threats from oak shrublands from roads and utility corridors associated with urban, exurban, commercial, and energy development are primarily in the southern and western portions of Colorado. Mixed mountain shrublands are somewhat less impacted by roads, primarily those associated with recreation areas or exurban housing.

7 Natural System Modifications

Fire is a source of disturbance in these shrublands, and they are highly fire tolerant. As with other habitats in the wildland-urban interface, areas near developed areas are most likely to be threatened by the effects of fire suppression, while more remote areas are generally in good condition. Gambel oak reproduces primarily by sprouting of new stems, especially after disturbances such as logging, fire, and grazing, although recruitment from seedlings does occur (Brown 1958; Harper et al. 1985).

11 Climate Change & Severe Weather

Oak and mixed mountain shrublands are widespread in western Colorado, and have a relatively wide ecological amplitude. Projected warming temperatures are likely to favor oak growth and persistence, although droughts and late frosts may affect the frequency of establishment through seedling recruitment by reducing the acorn crop in some years. In general, stands of these deciduous shrublands are thought to not be vulnerable to climate change.

Information Needs

An improved understanding of some component shrub species' (e.g., *Purshia tridentata*, *Quercus gambelii*) response to drought is needed.

Conservation Actions

Maintenance of appropriate patch size and mosaic is the primary conservation action needed.

Sagebrush

Threats

1 Residential & Commercial Development

Threats to sagebrush shrublands from exurban or recreational area development continues at a moderate level. Hunting and recreational are minor sources of disturbance in this habitat.

2 Incompatible Agriculture

Chemical and other mechanical shrub removal for forage grass production, and to a lesser extent conversion to tilled crops, is a substantial threat in western Colorado. Conversion of native sagebrush habitats to introduced forage plant species continues to occur at low levels. Grazing by large ungulates (both wildlife and domestic livestock) can change the structure and nutrient cycling of sagebrush shrublands (Manier and Hobbs 2007), but the interaction of grazing with other disturbances such as fire and invasive species under changing climatic conditions appears to be complex (e.g., Davies et al. 2009) and has not been well studied in Colorado.

3 Energy Production & Mining

Large coal mining operations that completely remove this habitat prior to reclamation activity are an ongoing threat to the connectivity and quality of these shrublands. Oil and gas development, with associated roads, pipeline corridors, and infrastructure is another ongoing source of anthropogenic disturbance, fragmentation, and loss in this habitat in northwestern Colorado.

4 Transportation Corridors

Roads and utility corridors associated with energy and exurban development are a source of habitat fragmentation for these shrublands.

7 Natural System Modifications

Fire suppression and long-term heavy grazing by domestic livestock may have contributed to the loss of native forbs and grasses, and increased growth of woody species such as juniper in some sagebrush habitats.

8 Invasives, Problematic Native Species, & Pathogens

Other stressors for sagebrush shrublands are invasion by cheatgrass and expansion of pinyon-juniper woodlands. Warmer, drier sites (typically found at lower elevations) are more easily invaded by cheatgrass (Chambers et al. 2007). There is a moderate potential for invasion by halogeton, knapweed species, oxeye daisy, leafy spurge, and yellow toadflax under changing climatic conditions, and a potential for changing fire dynamics to affect the ecosystem. Although sagebrush tolerates dry conditions and fairly cool temperatures, it is not fire adapted, and is likely to be severely impacted by intense fires that increase wind erosion and eliminate the seed bank (Schlaepfer et al. 2014). Increased fire frequency and severity in these shrublands could occur under future climate conditions, potentially increasing the area dominated by exotic grasses, especially cheatgrass (D'Antonio and Vitousek 1992; Shinneman and Baker 2009).

11 Climate Change & Severe Weather

Because these are shrublands of lower elevations, they are not expected to be limited by a requirement for cooler, high elevation habitat. Bradley (2010) points out that sagebrush

shrublands in the western U.S. are currently found across a wide latitudinal gradient (from about 35 to 48 degrees north latitude), which suggests adaptation to a correspondingly wide range of temperature conditions. However, because these shrublands are apparently able to dominate a zone of precipitation between drier saltbush shrublands and higher, somewhat more mesic pinyon-juniper woodland, the distribution of sagebrush shrublands is likely to be affected by changes in precipitation patterns (Bradley 2010). Although sagebrush is generally a poor seeder, with small dispersal distances, there are no apparent barriers to dispersal for these shrublands. These stands may also be somewhat vulnerable to changes in phenology.

Information Needs

Information needed includes improved understanding of: natural sagebrush community succession and climax states, long-term effects of past management actions, and reliable management techniques to combat non-native plant species invasion. Completion of NRCS Ecological Site Descriptions with accompanying state and transition models would be beneficial to sagebrush management in Colorado.

Conservation Actions

CPW has historically placed great emphasis on, and devoted considerable resources toward, protecting and enhancing sagebrush communities. CPW is presently implementing approximately 5,000 acres of sagebrush enhancement or restoration work annually. Similar or increased restoration effort will likely be required over the next 10 years to buffer projected sagebrush habitat loss. CPW will also continue protection activities through our Wildlife Habitat Protection Program, which over the last few years has preserved tens of thousands of acres of sagebrush habitat through fee title acquisitions and conservation easements. Many sagebrush dependent species require large tracts of contiguous sagebrush habitat to sustain viable populations. On an annual basis, the quantity of high quality sagebrush habitat on private lands offered to CPW through the Wildlife Habitat Incentive Program far exceeds program funding availability. Targeted expansion of these protection efforts would protect large unbroken tracts of sagebrush habitat in perpetuity.

Saltbush

Threats

1 Residential & Commercial Development

Saltbush shrublands have limited but ongoing threat of conversion to urban and commercial development that can increase habitat fragmentation.

2 Incompatible Agriculture

Saltbush shrublands have limited but ongoing threat of conversion to croplands. Many of the dominant shrubs are palatable to domestic livestock, so grazing can alter species composition.

3 Energy Production & Mining

Oil and gas development, with associated roads, pipeline corridors, and infrastructure is the primary ongoing source of anthropogenic disturbance, fragmentation, and loss in this habitat.

7 Natural System Modifications

Where substrates are shallow fine-textured soils developed from shale or alluvium, the naturally sparse plant cover makes these shrublands especially vulnerable to water and wind erosion, especially if vegetation has been depleted by grazing, anthropogenic disturbances, or fire. Historically, saltbush shrublands had low fire frequency (Simonin 2001), and are characterized by low fuel mass and low soil moisture, which tends to mitigate fire impacts (Allen et al. 2011). Many of the dominant shrubs are palatable to domestic livestock, so grazing can alter species composition as well as increasing erosion potential.

Information Needs

No high priority research needs have been identified for this habitat.

Conservation Actions

The highest priorities for saltbush habitats are improved grazing management, control of invasive weeds, and implementation of Best Management Practices for energy development.

Sandsage

Threats

1 Residential & Commercial Development

Sandsage shrublands have limited but ongoing threat of conversion to urban/exurban and commercial development.

2 Incompatible Agriculture

The greatest threat in sandsage systems is mis-managed grazing that has altered the grass and forb community structure under the sandsage. This habitat type is highly degraded in much of the state, resulting largely from uniform and intense livestock grazing over much of eastern Colorado. In northeast Colorado, there is evidence of declining and degraded component of the important grasses and forbs associated with sandsage due, in many cases, to historic mis-managed grazing followed by a long period of no grazing exacerbating the habitat issues. Under a “no-use” situation, most commonly observed on public lands and smaller parcels of property

owned for recreation properties (i.e., duck clubs) rather than as agricultural working lands, this habitat type tends to degrade to an excessive litter, low productivity state with few native perennial grasses. The system will then tend to be dominated by annuals, often invasive annuals such as cheatgrass. Mis-managed domestic livestock grazing tends to favor the increase of sandsage over associated native grasses. Long-term continuous grazing of domestic livestock has made a significant contribution to the alteration of these shrubland habitats from their pre-settlement condition, and this trend is likely to continue. Fire suppression may also contribute to an increase in shrub density in this habitat, although sandsage quickly resprouts after burning. Sandsage shrublands have limited but ongoing threat of conversion to row crop agriculture.

3 Energy Production & Mining

Oil and gas development and wind farms, along with associated roads, utility corridors, and infrastructure, are primary ongoing sources of anthropogenic disturbance, fragmentation, and loss in this habitat.

7 Natural System Modifications

Fire suppression and long-term heavy grazing by domestic livestock may have contributed to a loss of native forbs and grasses, and increased growth of woody species in some sandsage habitats. Cheatgrass encroachment is also an ongoing and increasing threat in this habitat type, especially in northeastern Colorado.

11 Climate Change & Severe Weather

Sandsage itself is resilient to drought, but extreme drought in combination with management actions that remove vegetation and litter could mobilize sandy substrates of this habitat, converting them to dunes.

Information Needs

There is a significant need to understand how to control or eliminate cheatgrass and recover the native mid and tall grass species that were historically present but are currently lacking.

Conservation Actions

Improving and implementing grazing systems that will return these systems to historic climax plant communities (HCPC) are needed. For these systems to provide wildlife habitat, they need to contain a diversity of vegetation height and condition, with a diverse suite of grasses, forbs, and legumes interspersed with the sandsage. Land protection strategies (e.g., conservation easements) can help avert conversion of sandsage from urban development, agriculture, and energy development.

Upland Shrub

Threats

1 Residential & Commercial Development

Ongoing threats from suburban or exurban development, roads, or recreational infrastructure are primarily concentrated in stands in the Front Range, and are a source of fragmentation, disturbance, and habitat loss.

2 Incompatible Agriculture

Grazing disturbance from over-use by domestic livestock can compact soils and alter species composition, nutrient levels, and vegetation structure in this habitat. Heavy concentrations of domestic livestock may have significant impacts on shrub growth and reproduction. Increasing small-acreage exurban development with livestock (“ranchettes”) appears to be increasing the incidence of weedy exotic species such as cheatgrass (*Bromus tectorum*) and leafy spurge (*Euphorbia esula*) in these habitats.

6 Human Intrusions & Disturbance

Hunting and associated vehicle noise or off-road use is a source of disturbance in these habitats.

7 Natural System Modifications

Fire is a naturally occurring, highly variable natural disturbance in this habitat, and response to fire is variable between shrub species. Many of the characteristic shrub species are quick to resprout after a fire. Fire suppression has allowed tree invasion in some areas, or the development of dense stands outside the range of natural historic variation. These dense communities dominated by old, decadent shrubs with substantial amounts of standing dead organic matter are susceptible to more intense fire and slower recovery. Ecotonal areas between grassland and ponderosa pine or juniper savanna may be especially vulnerable to successional changes.

8 Invasives, Problematic Native Species, & Pathogens

Over-use by native herbivores has the potential to alter environmental factors such as species composition, soil compaction, nutrient levels, and vegetation structure. These effects may be compounded by winter use by large populations of native ungulates. Over-utilization by locally overabundant native cervids can lead to a decline in vigor, over-browsing, and a reduction of the most palatable species in this habitat type.

11 Climate Change & Severe Weather

Projected warming temperatures by mid-century may alter the relative species composition of these shrublands, but little is known about the potential response of component species to changing climate.

Information Needs

Improved understanding of fire recovery, effects of weeds on fire regime, regeneration requirements for mountain mahogany (*Cercocarpus montanus*), and relationship(s) among different grazing regimes in different soil types and weed invasion is needed. Little is known about the potential effects of projected warming conditions on the species that dominate these shrublands.

Conservation Actions

Primary conservation needs are maintenance of appropriate patch size and mosaic, control of weeds, and improved grazing management.

GRASSLANDS

Foothill and Mountain Grasslands

Threats

1 Residential & Commercial Development

Native grassland habitat can be lost or fragmented by suburban and exurban development. Higher elevation grasslands on relatively flat sites are often in private ownership, and are often greatly sought after for residential development. The extensive grasslands of South Park, in particular, are threatened by the subdivision of large properties. Recreational use (public open space use in lower elevations; off-road vehicle and ATV use, hunters, packers, and snow mobilers in higher elevations) associated with increased human presence is an ongoing source of disturbance in this habitat.

2 Agriculture

Historically, soil disturbance in this habitat was largely the result of occasional concentrations of large native herbivores, or the digging action of fossorial mammals. Domestic livestock ranching has changed the timing and intensity of grazing disturbance from that of native herbivores, and generally has altered species composition, soil compaction, nutrient levels, and vegetation structure. In combination with grazing of domestic livestock, various “range improvement” activities (e.g., seeding, rodent control, herbicide application) have the potential to alter natural ecosystem processes and species composition. Increasing small-acreage exurban development

with livestock (“ranchettes”) appears to be increasing the incidence of weedy exotic species in these habitats. Exotics include *Linaria dalmatica*, *Centaurea spp.*, *Bromus inermis*, *B. tectorum*, *Melilotus officinalis*, and others. The current rate of conversion of lower elevation native grassland to cropland is low, but remains a threat for some limited areas.

4 Transportation Corridors

Native grassland habitat can also be lost or fragmented by suburban and exurban development, and transportation or utility infrastructure development. The extensive grasslands of South Park, in particular, are threatened by the development of transportation corridors.

7 Natural System Modifications

Historically, fire was a regular disturbance in these grassland habitats. Fire-return intervals have been considerably lengthened since settlement by European-Americans, and suppression has allowed the invasion of woody species, especially in combination with heavy grazing (Mast et al. 1997, 1998). Although woodlands and savannas are expected to occur naturally on the landscape, alteration of fire intensity and frequency, grazing, and changes in climate has resulted in various densities of younger trees occurring on sites that were once shrublands or grasslands (West 1999). Ecotonal areas between grassland and ponderosa pine or juniper savanna may be especially vulnerable to successional changes.

8 Invasives, Problematic Native Species, & Pathogens

Seeding with non-native pasture grasses and invasion by exotic forbs has altered species composition in these grassland habitats, and will continue to do so.

11 Climate Change & Severe Weather

Climate projections for mid-century indicate that foothill and mountain grasslands of Colorado will experience significant temperature increases. Vulnerability of these habitats to climate change is greater at elevations below 7,500 feet. The highly disturbed condition of most occurrences, especially at lower elevations, and the vulnerability of these areas to invasive species, are likely to interact with the rising temperature across much of the distribution of the habitat in Colorado to reduce resilience of these habitats.

Information Needs

An improved understanding of the potential impacts of climate change is needed.

Conservation Actions

Actions will depend upon which specific threats are impacting a site and must be planned on a site specific basis. Excessive off-road use will require significantly different conservation and management actions than will implementing a grazing plan to improve grassland habitat by altering timing, duration, and intensity of livestock production on private grasslands to address changes in plant height, density and composition.

Mixed and Tallgrass Prairie

Threats

1 Residential & Commercial Development

These grassland habitats can be fragmented by urban, suburban and exurban development, and associated infrastructure development.

2 Incompatible Agriculture

Grazing by domestic livestock, which differs in timing and intensity from grazing by native herbivores, is an ongoing threat that alters species composition, soil compaction, nutrient levels, and vegetation structure. Some areas may be vulnerable to runoff or drift of agricultural fertilizer and pesticides. Invasive species are most prevalent near areas disturbed by cultivation. The current rate of conversion of mixed-grass habitat to cropland has been comparatively low, but remains a threat for some limited areas in northeastern Colorado. Recent legislative reductions of Conservation Reserve Program acreage, together with improved prices for cultivated crops, have increased the likelihood that areas of this habitat will be converted to agricultural use. Remaining tallgrass areas are generally protected and not threatened by large scale habitat conversion, but past conversion to cropland has eliminated the majority of this habitat type in Colorado.

3 Energy Production & Mining

Energy development (oil and gas exploration and production, wind turbine farms) are a source of habitat fragmentation in mixed-grass habitats.

4 Transportation Corridors

Roads and utility corridors associated with urban, suburban, exurban, and energy development are a source of habitat fragmentation for these grasslands.

7 Natural System Modifications

Fire suppression has contributed to the increased growth of woody species in native grasslands (Bock and Bock 1998).

8 Invasives, Problematic Native Species, & Pathogens

Within the range of mixed-grass and tallgrass prairie in northeastern Colorado, major problem species include cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola kali*), Canada thistle (*Cirsium canadensis*), musk thistle (*Carduus nutans*), and knapweed (*Centaurea* spp.). Tallgrass habitat in Colorado is susceptible to invasion by non-native grasses such as smooth brome and Kentucky bluegrass.

11 Climate Change & Severe Weather

Under two widely-used climate change models (National Assessment Synthesis Team 2000), as levels of atmospheric CO₂ increase, the predicted scenario for much of the range of mixed-grass prairie in the Central Shortgrass Prairie Ecoregion is a shift away from grassland to either shrubland/woodland (under increased precipitation conditions) or arid land (under decreased precipitation).

Information Needs

An improved understanding of the potential impacts of climate change is needed.

Conservation Actions

This habitat type is very important to many grassland nesting birds in Colorado and most of the historic habitat has been converted to urban and agricultural uses. The use of conservation easements is the most effective tool to address development and conversion pressures where intact examples remain. Re-establishing this habitat type through programs such as the Conservation Reserve Program is a high priority for many species. Great care needs to be taken in the development of seed mixes, as experience has shown substantial issues in maintaining diverse mixed and tall grass habitat when certain aggressive native species (western wheatgrass and sideoats grama) or aggressive non-natives (smooth brome and crested wheatgrass) are included in mixes.

Mixed and tallgrass prairies still exists within functional landscapes associated with riparian creek bottoms and well managed sandhills in northeastern and east-central Colorado. In these situations, continuing or improving grazing management of domestic livestock is necessary to maintain or improve habitat condition. This habitat type is the most threatened and limited of the grassland habitat types in eastern Colorado, and wildlife use is extremely high where this habitat type has been restored.

Shortgrass Prairie

Threats

1 Residential & Commercial Development

Habitat loss is a continuing threat to shortgrass prairie. Residential and commercial development is a significant source of habitat loss and fragmentation on the western margins of Colorado's shortgrass prairie distribution; it is less so in other areas, but rarely entirely absent.

2 Incompatible Agriculture

In the northeastern portion of Colorado, patterns of land cultivation, including windbreaks, have largely fragmented the matrix of the shortgrass prairie, reducing or eliminating connectivity for species that depend on prairie habitats, and this trend is likely to continue. There has been significant conversion pressure in eastern Colorado the past several years as the commodity prices and federal crop insurance policies have combined to exert significant conversion pressure of all grassland types, including shortgrass prairie, to cropland.

Grazing by domestic livestock is the primary use of remaining shortgrass prairie. Management for increased livestock production tends to produce a more homogeneous grassland dominated by key forage species (Fuhlendorf and Engle 2001), and requires additional management effort to restore a mosaic of habitat structure suitable for characteristic wildlife species. Thus, there is an ongoing threat of habitat degradation or loss of function for shortgrass prairie.

3 Energy Production & Mining

Development of oil and gas resources is ongoing in shortgrass prairie habitat, especially in the Niobrara shale of the Denver-Julesburg Basin that lies under most of the northern portion of shortgrass prairie extent in Colorado. The density of associated roads, pipeline corridors, and infrastructure is a primary source of anthropogenic disturbance, fragmentation, and loss in this habitat. Disturbance from wind energy development remains small from a statewide perspective, but can have significant localized effects. Utility-scale solar installations have thus far been confined to areas near urban development, but there is a potential for future disturbance from this type of facility, which would require associated utility corridor development.

7 Natural System Modifications

Domestic livestock grazing and fire suppression have altered the natural fire regime of this habitat, contributing to changes in structure and species composition, including increased growth of woody species (Bock and Bock 1998).

8 Invasives, Problematic Native Species, & Pathogens

Within the range of shortgrass prairie in northeastern Colorado, major problem species include Russian thistle (*Salsola kali*), cheatgrass (*Bromus tectorum*), Canada thistle (*Cirsium canadensis*), musk thistle (*Carduus nutans*), and knapweed (*Centaurea* spp.).

11 Climate Change & Severe Weather

Climate projections for mid-century indicate that the eastern plains of Colorado will experience significant temperature increases, and an increase in drought days. Although the dominant species of this habitat are well adapted to warm and dry conditions, blue grama in particular can be slow to recover from drought. Warmer and drier conditions could lead to a shift in the relative abundance of shortgrass prairie species, with the resulting development of novel plant

communities. In particular, warmer night-time temperatures are likely to favor cool-season species, both native and exotic. However, due to uncertainties in future precipitation patterns, the effect of increasing temperatures on this habitat is difficult to predict.

Information Needs

An improved understanding of impacts of climate change is a significant need, as is better information on the relationship(s) among climate and ecological process (e.g., fire) factors and shrub invasion. Data on impacts of energy development are lacking.

Conservation Actions

This grassland habitat type is the most abundant in Colorado and, while degraded, is generally in better functioning ecological condition than the other grassland habitat types in eastern Colorado. The use of conservation easements is the most effective tool to address development and conversion pressures in this habitat type. Effective outreach to improve grazing management that restores vegetation condition, function, and structure will address other threats in this habitat type. Several important forbs, shrubs, and half shrubs (i.e., winterfat, native prairie clovers, leadplant) associated with this habitat type are absent or heavily reduced, negatively impacting wildlife habitat potential; this can be addressed by effectively implementing improved grazing management on public and private shortgrass prairies.

RIPARIAN AND WETLAND HABITATS

Playas

Threats

1 Residential & Commercial Development

Conversion of playa-containing watersheds to urban/exurban development, and associated roads or utility corridors is an ongoing threat to this habitat.

2 Incompatible Agriculture

Agriculture and associated infrastructure is a source of stressors such as culturally-accelerated sedimentation, pollution, runoff of fertilizer or pesticides, and invasion by exotic species. Specific agricultural stressors include tilling, and continuous, intensive grazing. Plowing can alter native plant communities, removing perennial plants and decreasing species richness (O'Connell et al. 2013). Potential effects of these changes on the quality of food and cover for SCGN in Colorado are generally unknown.

3 Energy Production & Mining

Energy development (especially oil and gas drilling) is another source of disturbance in these habitats, especially in the northern part of the eastern plains. Like urban development, primary issues revolve around direct habitat loss, as well as the fragmentation that occurs from roads, utility corridors, and associated infrastructure.

7 Natural System Modifications

Although most playas are already altered to some extent, the threat of additional direct hydrologic modification, or modifications within the immediate watershed, is ongoing for playa habitat in Colorado. Specific stressors include culturally-accelerated sedimentation, pit excavation to increase water storage, and runoff diversion.

8 Invasives, Problematic Native Species, & Pathogens

Altered playas may be more vulnerable to colonization by exotic species, although highly invasive species with the potential to dramatically alter habitat are generally not an issue. The potential consequences of the loss of native plant diversity in these habitats is not known.

9 Pollution

Both urban areas and rural croplands are sources of pesticide (Kimbrough and Litke 1996) or fertilizer runoff (Carpenter et al. 1998; White et al. 2003). Non-point source pollution is high in agricultural and urban landscapes of Colorado's eastern plains.

11 Climate Change & Severe Weather

Our climate change vulnerability analysis (Appendix F) indicated that playas in eastern Colorado are highly vulnerable to the effects of climate change by mid-century. The exposure of this habitat to projected increases in temperature and drought frequency, as well as the high level of previous anthropogenic impacts, are primary factors contributing to this assessment result. Although there are not very many direct effects of climate change on playas as geologic features, playas as functioning wetland habitat are likely to decrease under climate change.

Information Needs

Analyzing playa hydroperiods over time to determine if there are long-term declining trends due to climate change and/or hydrologic alterations is needed. It is unknown to what extent culturally-accelerated sedimentation is impacting playas in northeast Colorado. At some level, sedimentation is necessary for the formation of playas. Additional work needs to be done in Colorado to determine if increased or more rapid sedimentation is actually occurring, and if Colorado playas warrant management. It is generally assumed that they do, but applying general management treatments such as sediment removal has the potential to degrade or eliminate the playa if done incorrectly and without knowledge of whether the sediment load in the playa is actually excessive and in need of management.

Conservation Actions

Protection and restoration needs include 1) using newly-developed prioritization tools developed by the Playa Lakes Joint Venture to target playas and playa complexes for protection and restoration; 2) where warranted, restoring playa hydrology by filling pits, removing excess accumulated sediments where appropriate, and planting grass buffers, and 3) compatible site-specific management of grazing through fencing, providing alternate water sources, and grazing plans.

Site-specific assessment is the first and most important conservation action to apply to playas before initiating any management action. Depending on the outcome of the assessment, sediment removal and/or buffering may or may not be warranted. In many cases, standard playa recommendations are both unnecessary and can be detrimental. Playas require localized run-off to fill, and some level of small particulate clay sedimentation is necessary to maintain water levels and function. On occasion, buffers that are too large are so effective at slowing or preventing run-off that the playa basin does not fill, and playas are most important to wildlife when they have water in their basins. In all cases where possible, filling a pit or ditch dug out within the playa basin is warranted and necessary to restore proper hydrologic function. Pits should be filled with nearby spoils piles which are almost always directly adjacent to the pit, which will contain the clay sediments necessary to maintain the underlying clay pan. Ditches should simply be smoothed over. Where pits are used to provide water for livestock developing alternative upland water sources is preferable to having a pit.

Riparian Woodlands and Shrublands

This category combines many specific habitats across the range of elevational gradients in Colorado. The setting, function, and land uses within the habitats vary, depending on whether one is considering waterways in the eastern prairies and foothills, the high country, or the deserts and canyonlands of the western slope. Summaries of threats for these habitats are discussed by geographic region as needed.

Threats

1 Residential & Commercial Development

Colorado's riparian habitats continue to be threatened by urban, exurban, and recreational development in adjacent uplands. Effects of these activities can contribute to a gradual loss of habitat area and quality. Land use within the riparian area, as well as in adjacent upland areas, can fragment the landscape and reduce connectivity between riparian patches, and between riparian and upland areas. This adversely affects the quantity, quality, and movement of surface water and groundwater, cycling of nutrients, and dispersal of plants and animals in riparian

habitats. Roads, bridges, and other infrastructure associated with development can also fragment and degrade riparian habitats. In particular, the increase of impervious surface area associated with development can increase runoff, including non-point source pollution.

Eastern Plains

Urbanization is widespread along the western edge of the plains and in the foothills ecotones. In these areas the threat of habitat fragmentation and loss from residential development is ongoing.

Mountains

Threats to riparian woodlands and shrublands in mountain areas of Colorado vary with elevation. Residential and commercial development occurs in comparatively limited distribution, and tends to be more concentrated along major transportation corridors and near large recreational developments.

Western Slope

As in the eastern plains and mountainous regions of Colorado, altered hydrologic regime (e.g., dams, diversion, roads) is an important primary threat to riparian habitats on the West Slope. Threats to riparian habitats from ongoing urban and exurban development are generally less severe than on the Front Range, but not absent. Agricultural activities are ubiquitous in lower elevations, including irrigated tilled and untilled crops, and domestic livestock grazing. The greatest level of impact is in the vicinity of Grand Junction/Palisade, and in the four corners area of southwestern Colorado.

2 Incompatible Agriculture

Colorado's riparian habitats continue to be threatened by agricultural activities (e.g., crop production, livestock grazing, and concentrated animal feeding operations) in adjacent uplands. Across most of the eastern prairie, agricultural production, both ranching and cropland, is the dominant land use. Grazing is an ongoing land use in mountain and West Slope riparian areas. Many West Slope and lower elevation mountain riparian areas are irrigated and mowed for forage production. Effects of these activities can contribute to a gradual loss of habitat area and quality. Land use within the riparian area, as well as in adjacent upland areas, can fragment the landscape and reduce connectivity between riparian patches, and between riparian and upland areas. This adversely affects the quantity, quality, and movement of surface water and groundwater, cycling of nutrients, and dispersal of plants and animals in riparian habitats.

In riparian areas where livestock use is heavy, plant community composition and structure has been altered, as have channel morphology, water quality, soil structure, streamflow patterns, erosion and sedimentation rates (Schulz & Leininger 1990; Armour et al. 1994; Trimble and Mendel 1995; Belsky et al. 1999; Bestcha et al. 2013). This is especially true where cattle concentrate in riparian areas that are not protected by fencing. However, appropriate timing and intensity of grazing can be used as a management tool to improve the seasonal quality of habitat

used by some SGCN (e.g., Manier et al. 2013), if tradeoffs for various species requirements are considered (Van Horn et al. 2012).

3 Energy Production & Mining

Gravel mining is common along the larger rivers in Colorado. Impacts from this activity, as well as past and current impacts from other types of extractive mining, are widespread in the South Platte and Arkansas River basins, and throughout the high mountains and southwestern Colorado. Oil and gas production is a potentially significant source of impact, particularly in the South Platte basin and northwest Colorado.

4 Transportation & Service Corridors

Many of Colorado's larger rivers and streams have roads and/or railroads that run alongside or nearby. For many rural and less traveled roads, impacts are likely localized. In areas where road density is very high and road crossings are common, impacts to riparian habitats can be severe. Issues include altered flows, pollution, fragmentation, erosion and downcutting (incision) that leads to loss or degradation of wet meadows. The largest, most concentrated road density in the state is in the Front Range urban area. Other areas of significant impact include the intensively cultivated eastern plains (TNC in prep).

7 Natural System Modifications

Alteration of natural hydrological processes and resource consumption through groundwater pumping have considerably altered the pre-settlement condition of riparian, and wetland habitats, and are an ongoing threat. Dams, reservoirs, diversions, channelization, ditches and other human land uses alter the natural flow regime of streams, and can disrupt the ecological integrity of the riparian habitats. Habitat modifications for flood control can greatly reduce the spatial complexity of riparian and wetland habitat. Physical changes resulting from altered flow regimes include erosion and channelization, reduced complexity in channel morphology, reduced base and/or peak flows, lower water tables in floodplains, tree and shrub establishment on sandbars due to reduced scouring flows, and altered sediment transport and deposition in the floodplain (Poff et al. 1997).

Eastern Plains

Most hydrological alteration is due to agricultural needs, except in highly developed areas along the Front Range, where urban uses are overtaking agricultural use. Continued groundwater pumping from the Ogallala-High Plains aquifer has lowered the water table such that many formerly flowing streams are now dry for much of the year (Dodds 1997). The main stems of the South Platte and the Arkansas Rivers, as well as the Purgatoire and portions of the Republican Rivers, are highly impacted by reservoirs and dams (TNC in prep).

Mountains

Except at the highest elevations, few mountain aquatic and riparian habitats are without hydrological modification, and the ongoing stresses from reservoirs, dams, diversions, and similar alterations include downstream erosion and channelization, reduced channel morphology dynamics, reduced base and/or peak flows, lower water tables in floodplains, and reduced sediment deposition in the floodplain (Poff et al. 1997). The upper Colorado River, in particular, is highly impacted by reservoir storage (TNC in prep).

Western Slope

The construction of dams in the Colorado River Basin has fragmented and inundated riverine habitat. The altered timing, rate, quantity, and temperature of flows changes recruitment and survival patterns for riparian vegetation.

8 Invasives, Problematic Native Species, & Pathogens

Seeding with non-native pasture grasses and invasion by tamarisk and exotic forbs has already altered species composition in riparian habitats, and will continue to do so. Invasive species with the potential to alter ecosystem function (e.g., tamarisk) are an ongoing management challenge, especially along the Arkansas and Purgatoire Rivers in eastern Colorado, and the upper Colorado, Dolores, San Juan and White Rivers on the western slope (TNC in prep). These disturbances are likely to continue to reduce habitat area and quality in riparian habitats.

9 Pollution

Both urban areas and rural croplands are sources of pesticide (Kimbrough and Litke 1996) or fertilizer runoff (Carpenter et al. 1998; White et al. 2003). These stressors can affect the riparian community composition and structure. Non-point source pollution in Colorado riparian areas is highest in agricultural and urban landscapes in the eastern plains, and along developed stream corridors elsewhere.

11 Climate Change & Severe Weather

Riparian woodlands and shrublands throughout the state should probably be regarded as having some degree of vulnerability to climate change, especially the potential for increasing frequency and/or magnitude of multi-year droughts.

Information Needs

A critical need is an evaluation of the results of implemented restoration projects. Other information needs include developing assessment techniques, and conducting field-based assessments to determine the quantity and quality of riparian woodland and shrubland habitat currently available for Tier 1 wildlife species. Development of decision support tools is needed for prioritizing riparian woodland and shrubland habitats for conservation, based on anticipated benefits to Tier 1 wildlife species. Tools for determining flows needed to maintain healthy

riparian habitats, including spring peak flows, gradual recedence after the peak, and maintenance flows in summer, fall and winter need to be developed for many major rivers and minor streams.

Conservation Actions

Control of invasive vegetation and replanting with native species where appropriate is needed. Other needs include reducing erosion by restoring streambed and bank morphology and revegetating as appropriate; managing grazing to be compatible with habitat requirements; and clearing trees and shrubs from sandbars, and reshaping as appropriate to encourage overtopping and sand movement. Private Sector Standards and Codes should prohibit development in riparian zones within at least the 100-year floodplain.

Conservation actions needed for riparian areas on small streams include: restoration of degraded stream reaches; protecting seeps and springs from development; control of invasive species; compatible management of grazing (including native and non-native ungulates); proper placement of roads, road crossings, and culverts; and protection (e.g., via conservation easements) within watersheds that are important for wildlife. Conservation actions needed for riparian areas on large rivers include: restoration of hydrologic regime; restoration of degraded riparian areas and river beds; improved design of road crossings to eliminate erosion, down cutting, and head cutting; hay meadow restoration; avoidance of additional dam/diversions construction, and possible removal of obsolete or abandoned dams and diversions; and use of conservation easements to protect private lands that control or directly influence large stretches of river.

Wetlands

This category combines many distinctive habitats across the range of elevational gradients in Colorado. The setting, function, and land uses within the habitats vary, depending on whether one is considering wetlands in the eastern prairies and foothills, the high country, or the deserts and canyonlands of the western slope. Summaries of threats for these habitats are discussed by geographic region as needed.

Threats

1 Residential & Commercial Development

Wetlands of Colorado's eastern plains continue to be threatened by urban and exurban development, which contribute to a gradual loss of habitat area and quality. With the exception of lower elevations in the Front Range foothills, wetlands of other areas in Colorado are generally not threatened by additional residential or commercial development.

2 Incompatible Agriculture

Eastern Plains

Agricultural activities (e.g., crop production, livestock grazing, and concentrated animal feeding operations) in adjacent uplands, generally contribute to a gradual loss of wetland habitat area and quality. Many wetlands in eastern Colorado occur as a result of water developments for primarily agricultural purposes. While these wetlands have developed relatively recently, they provide important wetland habitat for many species. In these situations, water development has been a positive for wildlife and wetland habitat in Colorado. However, reallocation of this water from agricultural use to municipal use is a significant and increasing threat to many wetlands in eastern Colorado. Moreover, the creation of wetlands through water management activities is not always an adequate substitute for preservation of natural wetlands (Sueltenfuss et al. 2013). Timing and intensity of grazing can affect the seasonal quality of habitat used by some SGCN and may be suitable for use as a habitat management tool in these instances, if tradeoffs for various species requirements are considered (West and Messmer 2006).

Mountains

With the exception of the extensive wetlands of the San Luis Valley, where groundwater pumping and diversions are widespread, wetland habitats in mountain areas of Colorado are generally less threatened by agriculture than those in lower elevations of the state.

Western Slope

Hanging gardens are an especially fragile wetland type of the western slope. Where they are accessible to livestock, erosion, trampling, and introduction of exotic species are an ongoing threat.

4 Transportation & Service Corridors

In areas where road density is very high and road crossings are common, impacts to wetland habitats can be severe. Issues include altered hydrographs, pollution, and fragmentation that lead to loss or degradation of wetland habitat. The largest, most concentrated road density in the state is in the Front Range urban area. Other areas of significant impact include the intensively cultivated eastern plains (TNC in prep).

7 Natural System Modifications

Wetland habitats have been heavily impacted by anthropogenic water management (Gage and Cooper 2007). Altered hydrology due to dams, diversions, and groundwater pumping may interact with warming temperatures and changes in precipitation pattern to alter groundwater recharge rates, leading to drying or contraction of wetlands, including small seeps and springs that support hanging gardens. Lack of scouring flows in adjacent lotic habitat has resulted in sedimentation and dominance of late successional wetland plants in many floodplain wetlands (e.g., warm water sloughs). Prairie wetlands have evolved under a disturbance regime where

both annual variation in the hydrological cycle and the incidence or intensity of weather extremes such as drought and flooding from year to year interact with other natural processes to produce a diverse patchwork of community types and successional states that provide habitat for many wildlife species. In general, intensive water management has greatly altered the flooding regime of many marshes, with consequent changes in species composition and community structure.

8 Invasives, Problematic Native Species, & Pathogens

Altered wetlands may be more vulnerable to invasion by exotic species, or loss of diversity. Some wetlands, especially in urban and agricultural areas, have seen increased hydroperiods during the growing season and resulting monocultures of cattails.

9 Pollution

Both urban areas and rural croplands are sources of pesticide (Kimbrough and Litke 1996) or fertilizer runoff (Carpenter et al. 1998; White et al. 2003). These stressors can affect the wetland community composition and structure. Non-point source pollution in Colorado wetlands is highest in agricultural and urban landscapes in the eastern plains, and along developed valley corridors elsewhere.

11 Climate Change & Severe Weather

Wetlands throughout the state should probably be regarded as having some degree of vulnerability to climate change. Increased frequency and magnitude of drought is likely to have significant impact on these habitats.

Information Needs

Develop decision support tools for prioritizing wetland habitats for conservation, based on anticipated benefits to Tier 1 wildlife species. Also, develop assessment techniques and conduct field-based assessments to determine the quantity and quality of wetland habitat currently available for Tier 1 wildlife species, and to evaluate the results of restoration.

Conservation Actions

Restore wetlands and create new wetlands where possible by managing water and hydrology. Where appropriate, excavate sediments and protect wetlands from further sedimentation and erosion. Manage grazing and cattail monocultures to promote plant diversity. Reshape gravel ponds to increase shallow margins and promote establishment of wetland vegetation. Restore historic function of warm-water slough and wet meadow habitats. Employ land and water protection tools where possible to alleviate pressures from habitat conversion and hydrological modifications.

AQUATIC HABITATS

Aquatic and riparian habitats are inextricably linked in terms of ecological processes, and therefore, threats operating on one will often also impact the other. The setting, function, land uses, and threats within these habitats vary, depending in part on elevation, but also on whether one is considering waterways in the eastern prairies & foothills, the high country, or the deserts and canyonlands of the western slope. Regional differences are summarized as needed.

Although we have summarized aquatic and riparian habitats separately, there is inevitably some overlap in threats and actions.

Rivers

Threats

1 Residential & Commercial Development

Colorado's river habitats continue to be threatened by changes in water withdrawal patterns driven by commercial, urban, exurban, and recreational development. Land use within the catchment area can adversely affect the quantity, quality, and movement of surface water and groundwater, cycling of nutrients, and dispersal of plants and animals in aquatic habitats. Roads, culverts, bridges, and other infrastructure associated with development can also fragment and degrade aquatic habitats.

Eastern Plains

Urbanization is widespread along the western edge of the plains and in the foothills ecotones. According to an analysis by The Nature Conservancy, the eastern plains rivers and streams, including the Arkansas and the South Platte Rivers, are the most heavily impacted by urban consumptive use in Colorado. Rivers and streams are especially impacted in the urban area from Denver to the Wyoming border (TNC in prep).

Rio Grande Valley

Commercial development occurs in comparatively limited distribution in the vicinity of Alamosa, and residential development tends to be concentrated along major transportation corridors and near recreational areas.

Western Slope

Threats to aquatic habitats from ongoing urban and exurban development are generally less in most areas of Colorado's west slope in comparison with the Front Range, but not absent. Areas of greatest commercial or recreational development impact are in the valleys of the Colorado, Gunnison, and Uncompahgre rivers, while exurban development is widespread throughout southwestern Colorado.

2 Incompatible Agriculture

The primary impact of agricultural activities (e.g., crop production, livestock grazing, and concentrated animal feeding operations in adjacent uplands) on rivers is the withdrawal of surface and groundwater. Irrigation is the leading water use in Colorado, where on an annual basis, about two-thirds of all allocated surface water goes to this use (CDWR 2012). However, degradation of riparian vegetation, both through direct alteration by cultivation or mowing, and indirectly through modified water levels, also alters the habitat quality and food web that supports aquatic species. Some fish rely on habitat structure associated with downed woody riparian vegetation and temperature moderation provided by shade from overhanging vegetation. Riparian vegetation also contributes directly to the aquatic food web, as berries, leaf litter, and associated terrestrial invertebrates falling into the water support aquatic invertebrates and fish. Finally, riparian vegetation can buffer the effects of agricultural runoff into freshwater ecosystems.

Eastern Plains

According to an analysis by The Nature Conservancy, the eastern plains rivers and streams are heavily impacted by consumptive use for irrigation in the agricultural landscapes of the South Platte, Arkansas, and Republican River basins (TNC in prep).

Rio Grande Valley

Agriculture is a primary land use in the San Luis Valley, a source of impact related to consumptive use and an ongoing source of degradation of aquatic habitats at lower elevations, though not to the degree experienced on the eastern plains (TNC in prep).

Western Slope

Threats to aquatic habitats from agricultural activities are ubiquitous in lower elevations, including irrigated tilled and untilled crops, and domestic livestock grazing. The greatest level of impact is in the vicinity of Grand Junction/Palisade, the valley of the Gunnison and Uncompahgre south of Grand Mesa, and in the four corners area of southwestern Colorado. Irrigation contributes to high selenium concentrations in upper Colorado River, the Gunnison River, and the San Juan River (Anderson et al. 1961). Irrigation and groundwater pumping can result in high levels of selenium that may affect the survival and reproductive success some aquatic SGCN.

7 Natural System Modifications

Patterns of water flow and their interaction with local landforms and substrates at a variety of scales are the primary determinant of physical habitat for river organisms. Aquatic organisms evolved with and are adapted to the characteristic natural flow regime of their habitat; changes in flow regime can cause serious disruption to the reproduction and survival of many aquatic species, leading to an eventual loss of biodiversity (Poff et al. 1997; Bunn and Arthington 2002). Reduced connectivity in aquatic habitats, both in-stream, and between the river channel and

associated floodplain habitats, reduces habitat availability and diversity, with consequent negative effects on the population viability of aquatic species. Altered flow regimes, and trans-basin diversions can facilitate the invasion and establishment of exotic species (Bunn and Arthington 2002). Finally, riverine systems act to integrate and collect the effects of disturbances within the catchment, including those due to flow modification (Naiman et al. 2002).

Eastern Plains

Ongoing and extensive water diversions and impoundments in the Great Plains began in the 1860s, and, along with groundwater mining and transbasin diversions, have greatly altered the hydrologic regime of rivers on Colorado's eastern plains. Prior to settlement, the large rivers heading in the mountains (the South Platte and the Arkansas) would have experienced high flows in spring during snowmelt, and have been nearly dry during other times of year (Escher et al. 1983). Reservoir and diversion construction have decreased peak flows, and converted the hydrograph to a flatter, more consistent perennial flow, generally facilitating the development of riparian forest and narrower channels (Wohl et al. 2009). Alterations are particularly pronounced on the South Platte and Arkansas Rivers, and have had significant impacts on species that rely on these habitats, particularly many species of native fish that evolved with more variable flows. Colorado's obligations under the South Platte River Compact, Republican River Compact, and Arkansas River Compact also play a significant role in the regulation of flows in this region.

Rio Grande Valley

The northern part of the San Luis Valley is a hydrologically closed basin; in the southern part of the valley the Rio Grande River is the primary riverine habitat in the region. The upper Rio Grande is snowmelt fed, with peak flows during late spring to early summer. High year to year variability of streamflow level is characteristic of this river system and unregulated annual streamflow volume can differ by an order of magnitude (Llewellyn and Vaddey 2013).

Agricultural diversions began in the mid-19th century; at one point substantial flow was diverted from the Rio Grande to storage in the closed basin aquifer. Eventually, these diversions were reduced, and largely replaced by groundwater pumping. The hydrograph of the upper Rio Grande is less impacted by modifications than in lower reaches outside Colorado; however, in the San Luis Valley the requirements of the Rio Grande Compact with New Mexico and Texas affect the allocation of water.

Western Slope

Streamflow in western slope rivers comes mainly from winter storms that build snowpacks in the high mountains of western Colorado; snowmelt produces peak annual flows between April and July. Atmospheric circulation patterns and sea-surface temperatures produce high year to year variation in annual flow levels. Impoundments and diversions are common on most of Colorado's West Slope rivers, and have altered the annual hydrograph. The construction of dams in the Colorado River Basin has fragmented and inundated riverine habitat; altered timing,

rate, quantity, and temperature of flows; affected seasonal availability of aquatic habitats; decreased turbidity (i.e., loss of cover from predators, loss of sandy backwater habitat); and blocked fish passage. In particular, large dams such as Flaming Gorge, Navajo, and the Aspinall Unit, and associated alterations have directly influenced thermal and hydrological regimes in both the Lower and Upper Colorado River basins, with resultant adverse impacts to native fish species. The Colorado River and Upper Colorado River Compacts affect allocation and flow patterns for the entire western slope.

8 Invasives, Problematic Native Species, & Pathogens

The quality of river habitats for fish species of concern is degraded by the presence of non-native fish that compete with and/or hybridize with native species. Impoundments are widespread potential sources of non-native fish species, which in some cases escape into SGCN habitat to the detriment of the native fishes. The growth of non-native riparian plant species, especially tamarisk and Russian olive, alters flow patterns by stabilizing channels and reducing riverine habitat diversity. These species may also increase shading of aquatic habitats, and alter nutrient inputs, thereby changing food availability for native species.

9 Pollution

Eastern Plains

Mining and energy production impacts water quality, especially in the Arkansas (mining) and Purgatoire (coalbed methane) rivers. Issues include increased concentrations of pollutants (heavy metals, saline) and wastewater (alteration of stream flows as well as pollution). Stochastic events such as extreme rainstorms and mudslides can exacerbate these impacts, potentially leading to significant impacts on SGNC (e.g., extensive fish kills).

Mountains

Mining in Colorado has altered stream channel geometry, contributed to higher sediment loads, and released toxic substances such as heavy metals. Copper and cyanide from the Summitville Mine were released into the headwaters of the Alamosa River beginning in 1986 (Csiki and Martin 2008). The spill and chronic contamination from Summitville Mine downstream on Wightman Fork to Alamosa River and through Terrace Reservoir left the river and reservoir fishless¹⁶. In 1997, heavy metals from historic mines were flushed by a summer rainstorm into Kerber Creek. All fish in Kerber Creek died, along with 43% of the fish in a 4km stretch of San Luis Creek (Alves 1997a; Bestgen, Compton, Zelasko, and Alves 2003).

¹⁶ A new treatment facility at Summitville Mine has significantly improved water quality below Wightman Fork confluence on the Alamosa River to Terrace Reservoir.

Information Needs

Analysis of hydroperiods over time to determine flows needed to maintain riverine habitat diversity is needed. Decision support tools are needed for prioritizing rivers for conservation and restoration, based on anticipated benefits to Tier 1 wildlife species.

Conservation Actions

Conservation actions needed for large rivers include: restoration of key components of the hydrologic regime; restoration of degraded river beds; improved design of road crossings to eliminate erosion, down cutting, and head cutting; floodplain restoration; avoidance of additional dam/diversions construction, and possible removal of obsolete or abandoned dams and diversions; and use of conservation easements to protect private lands that control or directly influence large stretches of river.

Streams

Threats

1 Residential & Commercial Development

Stream habitats in Colorado continue to be threatened by changes in water withdrawal patterns driven by urban, exurban, and recreational development. Land use within the catchment area can adversely affect the quantity, quality, and movement of surface water and groundwater, cycling of nutrients, and dispersal of plants and animals in aquatic habitats. Roads, culverts, bridges, and other infrastructure associated with development can also fragment and degrade aquatic habitats. In most areas of Colorado, commercial development along streams occurs in comparatively limited distribution and residential development tends to be concentrated along major transportation corridors and near recreational areas. Urbanization is most prevalent along the western edge of the plains and in the foothills ecotones. Development and transportation corridors in mountain areas of Colorado are generally concentrated in valley bottoms along streams; in mountainous areas development associated with tourism and recreation is ongoing. Exurban development is widespread throughout western Colorado.

2 Incompatible Agriculture

The primary impact of agricultural activities (e.g., crop production, livestock grazing, and concentrated animal feeding operations in adjacent uplands) on streams is the withdrawal of surface and groundwater. Irrigation is the leading water use in Colorado, where on an annual basis, about two-thirds of all allocated surface water goes to this use (CDWR 2012).

Eastern Plains

Most streams of the eastern plains are characterized by intermittent surface flow, with dry stretches interrupted by pools that provide refuge habitat for plains fish. Flow patterns for these

streams are affected by changes in the water table level due to groundwater pumping and irrigation. These changes are most prevalent in areas overlying the Ogallala aquifer, which have been extensively developed for crop growing.

Rio Grande Valley

Appropriation of surface water streams for agricultural use in the valley began in the 1850s. By 1900, the natural flow on all surface streams in the valley was over-appropriated. Because the construction of reservoirs for surface water storage was hindered by a series of embargos on the use of federal lands for reservoir construction, crop growers began using the unconfined aquifer of the closed basin as a storage reservoir through the practice of subirrigation, substantially elevating the water table in the closed basin (District Court, Water Division No. 3, Colorado. Confined Aquifer New Use Rules for Division 3, Case No. 2004CW24, Findings of Fact, Conclusions of Law, Judgment and Decree, November 9, 2006). Eventually, the combination of reduced diversions from the Rio Grande River to the closed basin and increased groundwater pumping lowered the groundwater table, eliminating the possibility for subirrigation of agriculture or wetlands. In the San Luis Valley the requirements of the Rio Grande Compact with New Mexico and Texas also affect the allocation of water.

Western Slope

Valley bottoms throughout western Colorado are used for irrigated forage production (e.g., hay, alfalfa) and/or directly grazed. Diversions and storage dams are common.

7 Natural System Modifications

Patterns of water flow and their interaction with local landforms and substrates at a variety of scales are the primary determinant of physical habitat for stream organisms. Aquatic organisms evolved with and are adapted to the characteristic natural flow regime of their habitat; changes in flow regime can cause serious disruption to the reproduction and survival of many aquatic species, leading to an eventual loss of biodiversity (Poff et al. 1991; Bunn and Arthington 2002). Reduced connectivity in aquatic habitats, both in-stream, and between the stream channel and associated floodplain habitats, reduces habitat availability and diversity, with consequent negative effects on the population viability of aquatic species. Altered flow regimes, and trans-basin diversions can facilitate the invasion and establishment of exotic species (Bunn and Arthington 2002). Finally, stream systems act to integrate and collect the effects of disturbances within the catchment, including those due to flow modification (Naiman et al. 2002).

Eastern Plains

Changes in streamflow patterns create barriers to aquatic species movement (stream de-watering, fragmenting formerly-continuous stretches of free-flowing streams) and reduced habitat quality (e.g., altered turbidity levels and sediment concentrations). Even small structures such as irrigation intakes, v-notch gauges, and culverts act as barriers to native plains fishes, fragmenting habitat and reducing population viability (Wohl et al. 2009).

Transition Zone Streams

Hydrological modification to transition zone streams of the Colorado Front Range began with early mining practices, and was followed by extensive diversions and impoundments for agricultural and urban development (Wohl 2005). These modifications altered natural streamflow patterns, with consequent changes to sediment transport, water temperature, and in-stream habitat diversity.

Mountains

Unmodified streams display a mosaic of habitats created by flow and sedimentation patterns. Extensive removal of beaver throughout Colorado in the first half of the 19th century probably had a considerable effect on channel structure, diversity, and stability, as well as sediment levels in mountain streams (Wohl 2006). Placer mining was an even stronger agent of hydrologic modification in many areas. Diversion dams tend to shift habitat toward slower flow and increased fine sedimentation (Baker et al. 2011). The legacy of these historic anthropogenic disturbances is reduced habitat suitability for native species.

Western Slope

Water storage impoundments and diversions are common on most of Colorado's West Slope streams, and have altered the hydrograph of annual flow patterns. The construction of dams in the Colorado River Basin has fragmented and inundated stream habitat; altered timing, rate, quantity, and temperature of flows; affected seasonal availability of aquatic habitats; decreased turbidity (i.e., loss of cover from predators, loss of sandy backwater habitat); and blocked fish passage.

8 Invasives, Problematic Native Species, & Pathogens

The quality of river habitats for fish species of concern is degraded by the presence of non-native fish that compete with and/or hybridize with native species. In mountain streams, introduced salmonids are a threat to populations of native cutthroat trout. Impoundments are widespread potential sources of non-native fish species, which in some cases escape into SGCN habitat to the detriment of the native fishes. At lower elevations, the growth of non-native riparian plant species, especially tamarisk and Russian olive, alters flow patterns by stabilizing channels and reducing riverine habitat diversity. These species may also increase shading of aquatic habitats, and alter nutrient inputs, thereby changing food availability for native species. Finally, the freshwater diatom *Didymosphenia geminata* (commonly called didymo or rocksnot), although native to low-nutrient cold-water streams of the area, has the potential to become a problem in warmer, nutrient-rich systems because it is expanding its geographic range into such areas (Spaulding and Elwell 2007).

9 Pollution

Both urban areas and rural croplands are sources of pesticide (Kimbrough and Litke 1996) or fertilizer runoff (Carpenter et al. 1998; White et al. 2003). These stressors can affect the aquatic

community composition and resilience by increasing growth of algae, depleting oxygen levels, and direct mortality of aquatic species. Non-point source pollution in Colorado streams is highest in agricultural and urban landscapes in the eastern plains, and along developed stream corridors elsewhere.

11 Climate Change & Severe Weather

Transition Zone Streams

Under projected warming water temperatures at mid-century, the proportion of warm water reach length is likely to increase. Transitional areas would generally move up in elevation, and become concentrated in the mountain region. Without accounting for water temperatures maintained by storage release, cold water reaches may essentially disappear from the foothill streams of Colorado, and some species may not be able to migrate to suitable upstream reaches (Fink and Decker 2015).

Information Needs

Analysis of hydroperiods over time to determine flows needed to maintain stream habitat diversity is needed. Decision support tools are needed for prioritizing streams for conservation and restoration, based on anticipated benefits to Tier 1 wildlife species. Evaluation of impacts from roads on the smaller streams is needed. Roads that are near or cross a small stream often downcut or channel the water in such a way that the wetted area shrinks in size when the water is flushed through the area at a more rapid pace, and thus is not able to spread out across the floodplain.

Conservation Actions

Conservation actions needed for streams include: management of streamflows to maintain diversity of in-stream habitats; restoration of degraded stream reaches; protecting seeps and springs from development; control of invasive species; compatible management of grazing (including native and non-native ungulates); proper placement of roads, road crossings, and culverts; and protection (e.g., via conservation easements) within important wildlife watersheds.

Lakes and Reservoirs

Threats

1 Residential & Commercial Development

Most natural lakes in Colorado are not heavily impacted by development because they are small and located at high elevations. Residential and recreational development are a primary source of disturbance for reservoirs and shorelines, especially if connected with larger water bodies in locations favorable for recreational activity (e.g., scenic areas or easily accessible from urban areas). Smaller reservoirs associated with flood control or water storage on smaller streams are not generally impacted.

6 Human Intrusions & Disturbance

Both lakes and reservoirs provide habitat for SGCN, and recreational use of these areas can be a disturbance during seasonally important life cycle events (e.g., breeding, nesting) for some species.

9 Pollution

Atmospheric deposition (air pollutants deposited to ecosystems) occurs in both wet deposition through rain, snow, cloud or fog, and as dry deposition via dust and gases. Atmospheric nitrogen and sulfur deposition can change water chemistry and thereby impact aquatic vegetation, invertebrate communities, amphibians, and fish. High elevation lakes are particularly sensitive to nitrogen and sulfur deposition, and receive more deposition than lower elevations due to greater amounts of snow and rain. High elevation lakes are especially sensitive to acidification from sulfur and nitrogen deposition and excess nitrogen enrichment, although buffering capacity varies with local geology. Non-point sources of nitrogen and phosphorus (runoff from urban and agricultural areas) produce eutrophication resulting in algal blooms and fish kills in some reservoirs and lakes.

Information Needs

Identify areas where recreational activity may be impacting habitat use by Tier 1 wildlife species. Develop decision support tools for prioritizing lake or reservoir habitats for conservation, based on anticipated benefits to Tier 1 wildlife species. Also, develop assessment techniques and conduct field-based assessments to determine the quantity and quality of lake or reservoir habitat currently available for Tier 1 wildlife species, and to evaluate the results of restoration.

Conservation Actions

Manage water levels where possible to protect littoral habitat identified as important for Tier 1 wildlife species. Develop recreation management plans to mitigate and reduce human disturbance of Tier 1 wildlife species during key seasonal use.

OTHER HABITATS

Cliffs and Canyons

Threats

3 Energy Production & Mining

Throughout the state, sandstone, limestone, granite, and shale outcrops are quarried for a variety of uses, which essentially destroys the habitat. In eastern Colorado, wind energy development is frequently concentrated on outcrops and canyon rims, causing fragmentation, disturbance, and loss of habitat.

4 Transportation Corridors

Surface impacts by transportation corridor disturbance are largely due to road construction and maintenance, including rockfall mitigation.

6 Human Intrusions & Disturbance

A primary threat to this habitat is anthropogenic surface disturbance that leads to change in soil or substrate structure or change in vegetation structure. Canyons and outcrops of the eastern plains are subject to disturbance from military training activities in some areas. Many occurrences of this habitat are found on public lands where recreational use (especially climbing) can be a major source of disturbance.

7 Natural System Modifications

Cliffs and canyons are often part of water storage construction projects, and may be inundated or disturbed by dam construction. Hydrological modification due to water storage can change groundwater flow patterns for cliff habitats, with the potential to impact vegetation composition or persistence.

11 Climate Change & Severe Weather

The primary threat of changing climate in this habitat would be the potential for increased frequency of extreme storm events that result in floods and erosion.

Information Needs

No priority information needs have been identified.

Conservation Actions

The primary conservation need is maintenance of appropriate patch size and landscape mosaic.

Alpine

Threats

1 Residential & Commercial Development

Ongoing threats from development in alpine habitats are associated with recreation areas and activities, including associated roads and infrastructure; these are generally limited in extent.

2 Incompatible Agriculture

In southwestern Colorado, sheep grazing is a stressor with the potential to alter species composition in alpine habitats.

6 Human Intrusions & Disturbance

Camping, hiking, and other recreational activities can have locally severe impacts on vegetation, with the proliferation of social trails, as well as disturbance to wildlife. Impacts are greatest in areas that have access to popular “fourteener” climbs.

9 Pollution

Anthropogenic nitrogen deposition is an ongoing threat that can change patterns of plant growth and diversity in alpine habitats (Grantz et al. 2003).

11 Climate Change & Severe Weather

Our climate change vulnerability analysis (Appendix F) indicated that alpine habitats in Colorado are moderately vulnerable to the effects of climate change by mid-century. However, the location of this habitat at the highest available elevations, narrow biophysical envelope, and edge-of-range character of many constituent species combine to limit the potential for this habitat to persist in the long term under projected conditions. Invasive species have not previously been a threat in these habitats, but there is a possibility that this will change under future climatic conditions. Likewise, fire could become a future source of disturbance in these areas if trees are able to establish at higher elevations.

Information Needs

Investigations into the effects of climate change on alpine habitats and constituent species is needed.

Conservation Actions

Due to their unique locations within the state, and the fact that they are generally federally owned and managed landscapes, the primary conservation action for alpine habitats is to manage for viable condition.

Sand Dunes

Threats

2 Incompatible Agriculture

Smaller blowouts and sand dune habitats on the eastern plains of Colorado are often stabilized as part of grazing management, which can change species composition (Kelso et al. 2007). Stabilization practices and conversion to cropland may fragment or degrade these habitats.

6 Human Intrusions & Disturbance

Large sand dune fields and other unstable sandy habitats in Colorado have limited but ongoing threat from recreational use. Sand dunes in a few areas (North Dune Field in North Park) are vulnerable to disturbance by excessive OHV recreational use.

11 Climate Change & Severe Weather

Climate change has great potential to change the abundance and distribution of these habitats in Colorado, as has happened in the past (Muhs and Holliday 1995). The development, extent, and persistence of unstable sandy areas and dunes are tightly linked to local and regional hydrology, including both surface and groundwater. The dynamics of this habitat are affected by precipitation, sand supply, wind patterns, the adjacent topography, and surface flow in local drainages. The extent and movement of unstable sand is greater in periods of drought and higher temperatures; dune and sand sheet movement is projected to increase under future climate conditions (Muhs and Maat 1993).

Information Needs

Investigations into the effects of climate change on sand dune habitats and constituent species is needed.

Conservation Actions

Due to their unique locations within the state, and the fact that they are generally federally owned and managed, the primary conservation action for sand dune habitats is to manage for viable condition.

Hot Springs

Threats

1 Residential & Commercial Development

Most of Colorado's hot springs have been developed to some extent for recreational use. Effects of these often extensive alterations, and the associated recreational impacts, are unknown.

3 Energy Production & Mining

Although hot springs are a characteristic feature of geothermal energy, it is only in the Mt. Princeton area that hot spring habitat occurs in an area with sufficient potential for geothermal energy development to threaten the habitat.

Information Needs

Information about current condition and potential impacts of development for hot spring habitats is lacking.

Conservation Actions

The primary conservation action for hot springs habitats is to manage for viable condition of the species of concern.

Agriculture

Threats

Wildlife challenges in agriculture are mainly connected to the extent of cropped acreage in a landscape, and different methods and timing of agricultural practices. With the modernization of farming has come the reduction of diversity within agricultural fields. The progression to "clean" farming (removal of all weeds or non-cropland cover and utilization of every acre of a field) has removed much of the annual vegetation and other permanent wildlife cover that historically occurred adjacent to and within crop fields, and has reduced movement ability for wildlife throughout an agricultural landscape. Lack of diversity of cropping rotations, both within a field and across an entire area, has reduced potential wildlife cover by limiting the structural diversity and cover types that are present.

Mortality of wildlife within croplands during harvest is another common challenge, especially within hay fields. Modernization of swathing and harvest implements has increased equipment widths and increased harvest-associated mortality. Along with harvest techniques, the preparation of a field for the next crop can impact wildlife. Waste grain that remains on the ground after harvest can be a valuable food source for wildlife during the winter and spring

months. This is especially true for migrating species such as the greater sandhill cranes in the San Luis Valley, or waterfowl along the South Platte River. When a tillage operation is performed too early, the waste grain becomes inaccessible to wildlife.

In regions of the state where irrigated agriculture is predominant, dewatering cropland through water rights sale, lease, or other transfers can negatively impact wildlife habitat quantity and quality, with resulting decreases in wildlife populations in these areas. Cropland irrigation runoff can provide surface habitat through pooling and creation of wetland type features. This can be viewed as a benefit. Additionally the movement of agricultural water underground can augment water tables, increase vegetative growth in low areas and form artificial wetlands. Uncropped irrigation circles leave corners that may provide wildlife habitat benefits.

Conservation Actions

Primary conservation actions include increasing the diversity of vegetation on the landscape by incorporating multispecies cover crops into crop rotations, planting marginally productive acres in plant species that provide permanent wildlife cover, and implementing integrated pest management. Delayed harvest, especially on hay fields, to avoid the peak brood-rearing seasons and employing wildlife friendly harvest techniques (e.g., flushing bars, lower equipment speeds) would minimize wildlife mortalities during harvest. Placing conservation easements or forming co-operative agreements between landowners would help conserve water rights in key areas that are of great importance to waterbirds and other wildlife.

Conservation Reserve Program

Threats

Conservation Reserve Program (CRP) lands vary widely in plant composition with their geographic location in the state, the age of the planting, and any previous management they may have received. Declining habitat quality is a primary issue facing Colorado's CRP lands. Older CRP plantings typically are monocultures or low plant diversity stands trending towards monoculture, and often exhibit static and uniform vegetative structure. Newer stands may show higher plant diversity, but standard agency seed mixes for the program are low diversity and could be enhanced to maximize wildlife benefits. As new CRP sign-ups occur, more diverse seed mixes designed to address habitat limiting factors should be used to target local priority wildlife species. These seed mixes should be high diversity with a significant and diverse forb component. Aggressive grasses such as sideoats grama and western wheatgrass should be avoided to prolong the diversity of structure and plant composition of the grass stand to maintain wildlife habitat values.

Another primary threat to CRP lands is the overall loss of acres of this habitat type in the state. Nationally the number of acres that can be enrolled in the program has decreased from a high of 39 million to 26 million. In Colorado, the number of enrolled acres had decreased from 2.2 million to 1.8 million acres currently. With the decline in eligible acres in the program nationally, it is expected that the quantity of CRP acres in Colorado will continue to decline. If lands currently in CRP are not re-enrolled into the program, fields that have expired out of the program are most often converted back to production crop agriculture and their habitat value is lost. This has already occurred in core Colorado lesser prairie-chicken range, and is having clear negative impacts to the state's population of this federally threatened species. The reduced national acreage enrollment cap increases the difficulty for currently cropped lands to enter into the program due to increased competition, resulting in missed conservation value and negative impacts to habitat for several SGCN.

Conservation Actions

CRP lands can be managed to provide habitat benefits for many SGCN, although management must occur within the program policy framework of the Farm Service Agency. A major hindrance to maximizing CRP fields for wildlife benefits is the Emergency Use provision of CRP, which allows haying and/or grazing activities to occur during drought years, resulting in severe negative repercussions to habitat diversity and structure in Colorado, often eliminating wildlife habitat value for multiple years of the CRP contract, and often permanently altering the plant species composition in the field. Haying done incorrectly during drought situations can eliminate mid to tall warm season grasses and forbs that often provide necessary and generally lacking vegetative structure on the landscape, to the detriment of a large suite of grassland nesting birds and other wildlife. The Emergency Use activities allowed within the program are conducted with little regard to the impact on wildlife habitat during drought, and basic rules to leave a minimum amount of cover during these times is frequently not enforced.

Finally, CRP enrollment would benefit greatly from an educational effort to landowners on the part of state and federal agencies that promote the wildlife benefits of the program. CRP provides significant financial incentives for planting wildlife habitat that are not always understood by landowners. Increased outreach activities could lead to increased enrollment in targeted areas of the state, thereby benefitting target SGCN.

Table 8. Key Habitats Threats and Conservation Actions.

Sorted by Habitat Type and Habitat Name.

Forest

Aspen

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	<input type="checkbox"/>	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input type="checkbox"/>
Mammals	<i>Ochotona princeps</i>	American pika	<input type="checkbox"/>	Birds	<i>Aegolius funereus</i>	Boreal owl	<input type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Peucaea cassinii</i>	Cassin's finch	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Otus flammeolus</i>	Flammulated owl	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Birds	<i>Accipiter gentilis</i>	Northern goshawk	<input checked="" type="checkbox"/>
Mammals	<i>Gulo gulo</i>	Wolverine	<input type="checkbox"/>	Birds	<i>Contopus cooperi</i>	Olive-sided flycatcher	<input checked="" type="checkbox"/>
Plants	<i>Ipomopsis ramosa</i>	Coral ipomopsis	<input type="checkbox"/>	Birds	<i>Progne subis</i>	Purple martin	<input checked="" type="checkbox"/>
Plants	<i>Draba malpighiacea</i>	Whitlow-grass	<input type="checkbox"/>	Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input type="checkbox"/>
				Insects	<i>Pyrgus xanthus</i>	Xanthus skipper	<input type="checkbox"/>
				Mammals	<i>Sorex nanus</i>	Dwarf shrew	<input checked="" type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Lasiurus cinereus</i>	Hoary bat	<input checked="" type="checkbox"/>
				Plants	<i>Penstemon mensarum</i>	Grand Mesa penstemon	<input checked="" type="checkbox"/>
				Plants	<i>Botrychium lineare</i>	Narrowleaf grape fern	<input checked="" type="checkbox"/>
				Plants	<i>Draba smithii</i>	Smith whitlow-grass	<input type="checkbox"/>
				Plants	<i>Delphinium robustum</i>	Wahatoya Creek larkspur	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.1 Fire & Fire Suppression	Reduced acreage due to fire suppression	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	H
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H
01.3 Tourism & Recreation Areas	Roads, trails, ski areas	2.1 Site/Area Management	Coordinate on ecologically sensitive design of recreational facilities	M
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	M
05.3 Logging & Wood Harvesting	Altered native vegetation	2.1 Site/Area Management	Implement compatible forest management practices	M
08.2 Problematic Native Species	Native herbivore browsing	2.3 Habitat & Natural Process Restoration	Manage natural herbivory using context-appropriate methods (e.g., exclosures, fire, forest management)	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Avoid destruction of large tracts of native habitat	L

Table 8 - Continued.

Forest

Lodgepole Pine

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	<input type="checkbox"/>	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input type="checkbox"/>
Mammals	<i>Ochotona princeps</i>	American pika	<input type="checkbox"/>	Birds	<i>Aegolius funereus</i>	Boreal owl	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Peucaea cassinii</i>	Cassin's finch	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Accipiter gentilis</i>	Northern goshawk	<input checked="" type="checkbox"/>
Mammals	<i>Lynx canadensis</i>	Lynx	<input checked="" type="checkbox"/>	Birds	<i>Contopus cooperi</i>	Olive-sided flycatcher	<input checked="" type="checkbox"/>
Mammals	<i>Gulo gulo</i>	Wolverine	<input type="checkbox"/>	Insects	<i>Coloradia luskii</i>	Lusk's pinemoth	<input type="checkbox"/>
				Insects	<i>Agapema homogena</i>	Rocky Mountain agapema	<input type="checkbox"/>
				Mammals	<i>Martes americana</i>	American marten	<input checked="" type="checkbox"/>
				Mammals	<i>Sorex nanus</i>	Dwarf shrew	<input checked="" type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Clethrionomys gapperi</i>	Red-backed vole	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus americanus</i>	Snowshoe hare	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
08.2 Problematic Native Species	Insect outbreaks	2.1 Site/Area Management	Implement compatible forest management practices	H
01.1 Housing & Urban Areas	Exurban development	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M
05.3 Logging & Wood Harvesting	Altered native vegetation (clearcutting and salvage)	2.1 Site/Area Management	Implement compatible forest management practices	M
07.1 Fire & Fire Suppression	Altered fire regime (fire suppression leading to high intensity fires)	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
01.1 Housing & Urban Areas	Exurban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	L

Table 8 - Continued.

Forest

Mixed Conifer

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	<input type="checkbox"/>	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	<input type="checkbox"/>
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Peucaea cassinii</i>	Cassin's finch	<input checked="" type="checkbox"/>
Mammals	<i>Ochotona princeps</i>	American pika	<input type="checkbox"/>	Birds	<i>Otus flammeolus</i>	Flammulated owl	<input type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input checked="" type="checkbox"/>	Birds	<i>Strix occidentalis lucida</i>	Mexican spotted owl	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input checked="" type="checkbox"/>	Birds	<i>Accipiter gentilis</i>	Northern goshawk	<input checked="" type="checkbox"/>
Mammals	<i>Lynx canadensis</i>	Lynx	<input checked="" type="checkbox"/>	Birds	<i>Contopus cooperi</i>	Olive-sided flycatcher	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input checked="" type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input checked="" type="checkbox"/>	Insects	<i>Coloradia luski</i>	Lusk's pinemoth	<input type="checkbox"/>
Mammals	<i>Gulo gulo</i>	Wolverine	<input type="checkbox"/>	Insects	<i>Agapema homogena</i>	Rocky Mountain agapema	<input type="checkbox"/>
Plants	<i>Ipomopsis ramosa</i>	Coral ipomopsis	<input type="checkbox"/>	Insects	<i>Pyrgus xanthus</i>	Xanthus skipper	<input type="checkbox"/>
Plants	<i>Hackelia gracilentia</i>	Mesa Verde stickseed	<input type="checkbox"/>	Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input type="checkbox"/>
				Mammals	<i>Sorex nanus</i>	Dwarf shrew	<input checked="" type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Lasiurus cinereus</i>	Hoary bat	<input checked="" type="checkbox"/>
				Mammals	<i>Clethrionomys gapperi</i>	Red-backed vole	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus sparsiflorus</i>	Front Range milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Telesonix jamesii</i>	James telesonix	<input type="checkbox"/>
				Plants	<i>Botrychium lineare</i>	Narrowleaf grape fern	<input type="checkbox"/>
				Plants	<i>Ipomopsis aggregata ssp. weberi</i>	Rabbit Ears gilia	<input checked="" type="checkbox"/>
				Plants	<i>Draba smithii</i>	Smith whitlow-grass	<input type="checkbox"/>
				Plants	<i>Astragalus iodopetalus</i>	Violet milkvetch	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
08.2 Problematic Native Species	Western spruce budworm	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	M
11.1 Habitat Shifting & Alteration	Altered species composition	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	L
05.3 Logging & Wood Harvesting	Altered native vegetation	2.1 Site/Area Management	Implement compatible forest management practices	L
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

Table 8 - Continued.

Forest

Pinyon - Juniper

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input checked="" type="checkbox"/>	Amphibians	<i>Spea intermontana</i>	Great Basin spadefoot	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input checked="" type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Birds	<i>Aegolius funereus</i>	Boreal owl	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input checked="" type="checkbox"/>	Birds	<i>Peucaea cassinii</i>	Cassin's finch	<input checked="" type="checkbox"/>
Plants	<i>Lygodesmia doloresensis</i>	Dolores River skeletonplant	<input checked="" type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Plants	<i>Boechnera glareosa</i>	Dorn's rockcress	<input type="checkbox"/>	Birds	<i>Vireo vicinior</i>	Gray vireo	<input checked="" type="checkbox"/>
Plants	<i>Pediocactus knowltonii</i>	Knowlton cactus	<input checked="" type="checkbox"/>	Birds	<i>Baeolophus ridgwayi</i>	Juniper titmouse	<input checked="" type="checkbox"/>
Plants	<i>Astragalus humillimus</i>	Mancos milkvetch	<input type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input checked="" type="checkbox"/>
Plants	<i>Hackelia gracilentia</i>	Mesa Verde stickseed	<input checked="" type="checkbox"/>	Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	<input checked="" type="checkbox"/>
Plants	<i>Astragalus schmollii</i>	Schmoll milkvetch	<input checked="" type="checkbox"/>	Birds	<i>Strix occidentalis lucida</i>	Mexican spotted owl	<input checked="" type="checkbox"/>
Plants	<i>Penstemon scariosus var. albifluvis</i>	White River penstemon	<input type="checkbox"/>	Birds	<i>Accipiter gentilis</i>	Northern goshawk	<input checked="" type="checkbox"/>
				Birds	<i>Contopus cooperi</i>	Olive-sided flycatcher	<input checked="" type="checkbox"/>
				Birds	<i>Gymnorhinus cyanocephalus</i>	Pinyon jay	<input checked="" type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input checked="" type="checkbox"/>
				Insects	<i>Callophrys comstocki</i>	Comstock's hairstreak	<input checked="" type="checkbox"/>
				Insects	<i>Incisalia fotis</i>	Early elfin	<input type="checkbox"/>
				Insects	<i>Callophrys mossii schryveri</i>	Moss's elfin	<input checked="" type="checkbox"/>
				Insects	<i>Euphilotes spaldingi</i>	Spalding's blue	<input checked="" type="checkbox"/>
				Insects	<i>Pyrgus xanthus</i>	Xanthus skipper	<input type="checkbox"/>
				Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input checked="" type="checkbox"/>
				Mammals	<i>Nyctinomops macrotis</i>	Big free-tailed bat	<input checked="" type="checkbox"/>
				Mammals	<i>Thomomys bottae rubidus</i>	Botta's pocket gopher (rubidus ssp)	<input type="checkbox"/>
				Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input checked="" type="checkbox"/>
				Mammals	<i>Sorex nanus</i>	Dwarf shrew	<input type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Lasiurus cinereus</i>	Hoary bat	<input checked="" type="checkbox"/>
				Plants	<i>Lepidium crenatum</i>	Alkaline pepperwort	<input checked="" type="checkbox"/>
				Plants	<i>Nuttallia densa</i>	Arkansas Canyon stickleaf	<input checked="" type="checkbox"/>
				Plants	<i>Herrickia horrida</i>	Canadian River spiny aster	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus debequaeus</i>	DeBeque milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Penstemon degeneri</i>	Degener beardtongue	<input checked="" type="checkbox"/>
				Plants	<i>Camissonia eastwoodiae</i>	Eastwood evening primrose	<input type="checkbox"/>
				Plants	<i>Astragalus piscator</i>	Fisher Towers milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Penstemon fremontii var. glabrescens</i>	Fremont's beardtongue	<input checked="" type="checkbox"/>
				Plants	<i>Nuttallia chrysantha</i>	Golden blazing star	<input type="checkbox"/>
				Plants	<i>Physaria vicina</i>	Good-neighbor bladderpod	<input checked="" type="checkbox"/>
				Plants	<i>Penstemon grahamii</i>	Graham beardtongue	<input type="checkbox"/>
				Plants	<i>Astragalus equisolensis</i>	Horseshoe milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Thelypodopsis juniperorum</i>	Juniper tumble mustard	<input checked="" type="checkbox"/>
				Plants	<i>Aletes maddougallii ssp. brevibradiatus</i>	Mesa Verde aletes	<input type="checkbox"/>
				Plants	<i>Astragalus naturitensis</i>	Naturita milkvetch	<input type="checkbox"/>
				Plants	<i>Oreocarya osterhoutii</i>	Osterhout cat's-eye	<input type="checkbox"/>

Table 8 - Continued.

Plants	<i>Lupinus crassus</i>	Payson lupine	<input checked="" type="checkbox"/>
Plants	<i>Penstemon scariosus</i> <i>var. cyanomontanus</i>	Plateau penstemon	<input checked="" type="checkbox"/>
Plants	<i>Astragalus rafaensis</i>	San Rafael milkvetch	<input checked="" type="checkbox"/>
Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input type="checkbox"/>
Reptiles	<i>Hypsiglena</i> <i>chlorophaea</i>	Desert nightsnake	<input checked="" type="checkbox"/>
Reptiles	<i>Gambelia wislizenii</i>	Long-nosed leopard lizard	<input checked="" type="checkbox"/>
Reptiles	<i>Crotalus oregonus</i> <i>concolor</i>	Midget faded rattlesnake	<input checked="" type="checkbox"/>
Reptiles	<i>Rena dissectus</i>	New Mexico threadsnake	<input checked="" type="checkbox"/>
Reptiles	<i>Phrynosoma</i> <i>modestum</i>	Round-tailed horned lizard	<input checked="" type="checkbox"/>
Reptiles	<i>Tantilla horbartsmithi</i>	Smith's black-headed snake	<input checked="" type="checkbox"/>
Reptiles	<i>Lampropeltis</i> <i>triangulum taylori</i>	Utah milksnake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation, woody encroachment, chaining sagebrush, seral stage imbalance, etc.)	2.1 Site/Area Management	Implement compatible forest management practices	M
08.2 Problematic Native Species	Ips outbreaks, black stain root disease	2.1 Site/Area Management	Implement compatible forest management practices	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Prepare climate change adaptation strategy to identify and address barriers to species movement and habitat shifting	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.1 Legislation	Promote zoning that concentrates use and protects habitat	L
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	L
06.1 Recreational Activities	Increasing disturbance from horseback riding, ATV use, bicycling	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
06.2 War, Civil Unrest & Military Exercises	Military training disturbance at Fort Carson and Pinon Canyon Maneuver Site	7.2 Alliance & Partnership Development	Coordinate with related agencies to align goals, policies, measures of success, etc.	L
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

Table 8 - Continued.

Forest

Ponderosa Pine

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input checked="" type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input checked="" type="checkbox"/>	Birds	<i>Aegolius funereus</i>	Boreal owl	<input type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Birds	<i>Peucaea cassinii</i>	Cassin's finch	<input checked="" type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input checked="" type="checkbox"/>	Birds	<i>Otus flammeolus</i>	Flammulated owl	<input checked="" type="checkbox"/>
Plants	<i>Boechea glareosa</i>	Dorn's rockcress	<input type="checkbox"/>	Birds	<i>Setophaga graciae</i>	Grace's warbler	<input checked="" type="checkbox"/>
Plants	<i>Ipomopsis polyantha</i>	Pagosa skyrocket	<input type="checkbox"/>	Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	<input checked="" type="checkbox"/>
				Birds	<i>Strix occidentalis lucida</i>	Mexican spotted owl	<input checked="" type="checkbox"/>
				Birds	<i>Accipiter gentilis</i>	Northern goshawk	<input checked="" type="checkbox"/>
				Birds	<i>Contopus cooperi</i>	Olive-sided flycatcher	<input checked="" type="checkbox"/>
				Birds	<i>Gymnorhinus cyanocephalus</i>	Pinyon jay	<input checked="" type="checkbox"/>
				Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input checked="" type="checkbox"/>
				Insects	<i>Incisalia fotis</i>	Early elfin	<input checked="" type="checkbox"/>
				Insects	<i>Coloradia luski</i>	Lusk's pinemoth	<input checked="" type="checkbox"/>
				Insects	<i>Callophrys mossii schryveri</i>	Moss's elfin	<input checked="" type="checkbox"/>
				Insects	<i>Hesperia leonardus montana</i>	Pawnee montane skipper	<input checked="" type="checkbox"/>
				Insects	<i>Agapema homogena</i>	Rocky Mountain agapema	<input type="checkbox"/>
				Insects	<i>Euphilotes spaldingi</i>	Spalding's blue	<input type="checkbox"/>
				Insects	<i>Pyrgus xanthus</i>	Xanthus skipper	<input type="checkbox"/>
				Mammals	<i>Sciurus aberti</i>	Abert's squirrel	<input checked="" type="checkbox"/>
				Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input checked="" type="checkbox"/>
				Mammals	<i>Sorex nanus</i>	Dwarf shrew	<input checked="" type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Lasiurus cinereus</i>	Hoary bat	<input checked="" type="checkbox"/>
				Plants	<i>Aletes humilis</i>	Larimer aletes	<input type="checkbox"/>
				Plants	<i>Astragalus missouriensis var. humistratus</i>	Missouri milkvetch	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
07.1 Fire & Fire Suppression	Altered native vegetation (increased tree density)	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	H
11.1 Habitat Shifting & Alteration	Habitat shifting, climate interaction with natural processes e.g. fire.	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
04.1 Roads & Railroads	Roads or Railroads	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	L
05.3 Logging & Wood Harvesting	Altered native vegetation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	L
08.2 Problematic Native Species	Altered habitat due to mountain pine beetle	2.1 Site/Area Management	Implement compatible forest management practices	L

Table 8 - Continued.

Forest

Spruce - Fir

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	<input type="checkbox"/>	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input type="checkbox"/>
Mammals	<i>Ochotona princeps</i>	American pika	<input type="checkbox"/>	Birds	<i>Aegolius funereus</i>	Boreal owl	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Peucaea cassinii</i>	Cassin's finch	<input checked="" type="checkbox"/>
Mammals	<i>Lynx canadensis</i>	Lynx	<input checked="" type="checkbox"/>	Birds	<i>Otus flammeolus</i>	Flammulated owl	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Birds	<i>Contopus cooperi</i>	Olive-sided flycatcher	<input checked="" type="checkbox"/>
Plants	<i>Ipomopsis ramosa</i>	Coral ipomopsis	<input checked="" type="checkbox"/>	Mammals	<i>Martes americana</i>	American marten	<input checked="" type="checkbox"/>
Plants	<i>Physaria scrotiformis</i>	West Silver bladderpod	<input type="checkbox"/>	Mammals	<i>Sorex nanus</i>	Dwarf shrew	<input checked="" type="checkbox"/>
Plants	<i>Draba malpighiacea</i>	Whitlow-grass	<input type="checkbox"/>	Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Lasiurus cinereus</i>	Hoary bat	<input checked="" type="checkbox"/>
				Mammals	<i>Sorex hoyi montanus</i>	Pygmy shrew	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus americanus</i>	Snowshoe hare	<input checked="" type="checkbox"/>
				Plants	<i>Townsendia rothrockii</i>	Rothrock townsend-daisy	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
08.2 Problematic Native Species	Insect outbreaks	2.1 Site/Area Management	Implement compatible forest management practices	H
05.3 Logging & Wood Harvesting	Logging and hazard tree salvage	2.1 Site/Area Management	Implement compatible forest management practices	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

Forest

Subalpine Limber - Bristlecone Pine

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input type="checkbox"/>
Mammals	<i>Gulo gulo</i>	Wolverine	<input type="checkbox"/>	Birds	<i>Aegolius funereus</i>	Boreal owl	<input type="checkbox"/>
				Birds	<i>Peucaea cassinii</i>	Cassin's finch	<input checked="" type="checkbox"/>
				Birds	<i>Otus flammeolus</i>	Flammulated owl	<input type="checkbox"/>
				Birds	<i>Contopus cooperi</i>	Olive-sided flycatcher	<input checked="" type="checkbox"/>
				Birds	<i>Gymnorhinus cyanocephalus</i>	Pinyon jay	<input checked="" type="checkbox"/>
				Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input type="checkbox"/>
				Mammals	<i>Sorex nanus</i>	Dwarf shrew	<input type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
08.1 Invasive Non-Native/Alien Species	White pine blister rust	2.2 Invasive/Problematic Species Control	Manage recreation and other human disturbances to control the spread of pathogens	H
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	5.2 Policies & Regulations	Prepare climate change adaptation strategy to identify and address barriers to species movement and habitat shifting	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

Table 8 - Continued.

Shrub

Desert Shrub

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Leucosticte australis</i>	Brown-capped rosy-finch	<input type="checkbox"/>	Amphibians	<i>Spea intermontana</i>	Great Basin spadefoot	<input checked="" type="checkbox"/>
Birds	<i>Athene cunicularia</i>	Burrowing owl	<input checked="" type="checkbox"/>	Birds	<i>Spizella breweri</i>	Brewer's sparrow	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Birds	<i>Charadrius montanus</i>	Mountain plover	<input type="checkbox"/>	Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input checked="" type="checkbox"/>
Mammals	<i>Mustela nigripes</i>	Black-footed ferret	<input type="checkbox"/>	Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input type="checkbox"/>
Mammals	<i>Cynomys gunnisoni</i>	Gunnison's prairie dog	<input checked="" type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Insects	<i>Hemileuca neumoegei</i>	A buckmoth	<input checked="" type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i> ssp.	Townsend's big-eared bat	<input type="checkbox"/>	Insects	<i>Callophrys comstocki</i>	Comstock's hairstreak	<input checked="" type="checkbox"/>
Mammals	<i>Cynomys leucurus</i>	White-tailed prairie dog	<input checked="" type="checkbox"/>	Insects	<i>Euphilotes rita emmeli</i>	Desert buckwheat blue	<input checked="" type="checkbox"/>
				Insects	<i>Incisalia fotis</i>	Early elfin	<input type="checkbox"/>
				Insects	<i>Bombus morrisoni</i>	Morrison bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Mammals	<i>Nyctinomops macrotis</i>	Big free-tailed bat	<input checked="" type="checkbox"/>
				Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input type="checkbox"/>
				Mammals	<i>Vulpes macrotis</i>	Kit fox	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input type="checkbox"/>
				Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input type="checkbox"/>
				Reptiles	<i>Lampropeltis californiae</i>	California kingsnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Hypsiglena chlorophaea</i>	Desert nightsnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Sceloporus magister</i>	Desert spiny lizard	<input checked="" type="checkbox"/>
				Reptiles	<i>Gambelia wislizenii</i>	Long-nosed leopard lizard	<input checked="" type="checkbox"/>
				Reptiles	<i>Crotalus oreganus concolor</i>	Midget faded rattlesnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Tantilla horbartsmithi</i>	Smith's black-headed snake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.1 Oil & Gas Drilling	Disturbance from exploration and production, and associated spread of noxious weeds	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
11.2 Droughts	Potential for conversion to exotic grasslands	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	M
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
03.3 Renewable Energy	Concentrated solar power development	4.2 Training	Educate development industries about avoiding and/or mitigating wildlife impacts	L
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	L

Table 8 - Continued.

Shrub

Greasewood

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Spizella breweri</i>	Brewer's sparrow	<input type="checkbox"/>
Mammals	<i>Cynomys gunnisoni</i>	Gunnison's prairie dog	<input type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Reptiles	<i>Aspidoscelis neotesselata</i>	Colorado checkered whiptail	<input checked="" type="checkbox"/>	Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Amphispiza belli</i>	Sage sparrow	<input checked="" type="checkbox"/>
				Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input type="checkbox"/>
				Mammals	<i>Vulpes macrotis</i>	Kit fox	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input type="checkbox"/>
				Plants	<i>Lepidium crenatum</i>	Alkaline pepperwort	<input type="checkbox"/>
				Reptiles	<i>Hypsiglena chlorophaea</i>	Desert nightsnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Gambelia wislizenii</i>	Long-nosed leopard lizard	<input checked="" type="checkbox"/>
				Reptiles	<i>Crotalus oreganus concolor</i>	Midget faded rattlesnake	<input type="checkbox"/>
				Reptiles	<i>Tantilla horbartsmithi</i>	Smith's black-headed snake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland, groundwater pumping, runoff from fertilizers & pesticides	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Avoid destruction of large tracts of native habitat	M
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	M
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	L

Table 8 - Continued.

Shrub

Oak and Mixed Mountain Shrublands

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	<input checked="" type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input checked="" type="checkbox"/>	Birds	<i>Setophaga graciae</i>	Grace's warbler	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input checked="" type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input checked="" type="checkbox"/>
Mammals	<i>Cynomys gunnisoni</i>	Gunnison's prairie dog	<input type="checkbox"/>	Birds	<i>Selasphorus rufus</i>	Rufous hummingbird	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input checked="" type="checkbox"/>
				Insects	<i>Incisalia fotis</i>	Early elfin	<input checked="" type="checkbox"/>
				Insects	<i>Bombus morrisoni</i>	Morrison bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Eurystrymon favonius ontario</i>	Northern hairstreak	<input checked="" type="checkbox"/>
				Insects	<i>Anisota oslari</i>	Oslar's oakworm moth	<input checked="" type="checkbox"/>
				Insects	<i>Hesperia ottoe</i>	Ottoe skipper	<input type="checkbox"/>
				Insects	<i>Euphilotes spaldingi</i>	Spalding's blue	<input type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input checked="" type="checkbox"/>
				Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Sorex preblei</i>	Preble's shrew	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input type="checkbox"/>
				Plants	<i>Penstemon mensarum</i>	Grand Mesa penstemon	<input type="checkbox"/>
				Plants	<i>Astragalus missouriensis</i> var. <i>humistratus</i>	Missouri milkvetch	<input checked="" type="checkbox"/>
				Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input type="checkbox"/>
				Reptiles	<i>Lampropeltis triangulum taylori</i>	Utah milksnake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences)	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	L
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	L

Table 8 - Continued.

Shrub

Sagebrush

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Leucosticte australis</i>	Brown-capped rosy-finch	<input type="checkbox"/>	Amphibians	<i>Spea intermontana</i>	Great Basin spadefoot	<input checked="" type="checkbox"/>
Birds	<i>Athene cunicularia</i>	Burrowing owl	<input type="checkbox"/>	Birds	<i>Leucosticte atrata</i>	Black rosy-finch	<input type="checkbox"/>
Birds	<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	<input checked="" type="checkbox"/>	Birds	<i>Spizella breweri</i>	Brewer's sparrow	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input checked="" type="checkbox"/>	Birds	<i>Aimophila cassinii</i>	Cassin's sparrow	<input type="checkbox"/>
Birds	<i>Centrocercus urophasianus</i>	Greater sage-grouse	<input checked="" type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Birds	<i>Centrocercus minimus</i>	Gunnison sage-grouse	<input checked="" type="checkbox"/>	Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input type="checkbox"/>
Mammals	<i>Mustela nigripes</i>	Black-footed ferret	<input type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
Mammals	<i>Cynomys gunnisoni</i>	Gunnison's prairie dog	<input checked="" type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Birds	<i>Amphispiza belli</i>	Sage sparrow	<input checked="" type="checkbox"/>
Mammals	<i>Cynomys leucurus</i>	White-tailed prairie dog	<input checked="" type="checkbox"/>	Birds	<i>Asio flammeus</i>	Short-eared owl	<input checked="" type="checkbox"/>
Plants	<i>Eriogonum brandegeei</i>	Brandegee wild buckwheat	<input type="checkbox"/>	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
Plants	<i>Physaria pulvinata</i>	Cushion bladderpod	<input checked="" type="checkbox"/>	Insects	<i>Callophrys comstocki</i>	Comstock's hairstreak	<input type="checkbox"/>
Plants	<i>Boechera glareosa</i>	Dorn's rockcress	<input type="checkbox"/>	Insects	<i>Bombus morrisoni</i>	Morrison bumblebee	<input checked="" type="checkbox"/>
Plants	<i>Lepidium huberi</i>	Huber's pepperwort	<input checked="" type="checkbox"/>	Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
Plants	<i>Astragalus osterhoutii</i>	Kremmling milkvetch	<input checked="" type="checkbox"/>	Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
Plants	<i>Gutierrezia elegans</i>	Lone Mesa snakeweed	<input checked="" type="checkbox"/>	Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input type="checkbox"/>
Plants	<i>Penstemon penlandii</i>	Penland penstemon	<input checked="" type="checkbox"/>	Mammals	<i>Canis lupus</i>	Gray wolf	<input type="checkbox"/>
Plants	<i>Physaria rollinsii</i>	Rollins twinpod	<input checked="" type="checkbox"/>	Mammals	<i>Vulpes macrotis</i>	Kit fox	<input checked="" type="checkbox"/>
Plants	<i>Astragalus microcymbus</i>	Skiff milkvetch	<input checked="" type="checkbox"/>	Mammals	<i>Sorex preblei</i>	Preble's shrew	<input type="checkbox"/>
Plants	<i>Phacelia gina-glenneae</i>	Troublesome phacelia	<input checked="" type="checkbox"/>	Mammals	<i>Brachylagus idahoensis</i>	Pygmy rabbit	<input checked="" type="checkbox"/>
				Mammals	<i>Lemmyscus curtatus</i>	Sagebrush vole	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input type="checkbox"/>
				Plants	<i>Cirsium perplexans</i>	Adobe thistle	<input checked="" type="checkbox"/>
				Plants	<i>Lepidium crenatum</i>	Alkaline pepperwort	<input type="checkbox"/>
				Plants	<i>Oxytropis besseyi</i> var. <i>obnapiformis</i>	Bessey locoweed	<input checked="" type="checkbox"/>
				Plants	<i>Lomatium concinnum</i>	Colorado desert-parsley	<input checked="" type="checkbox"/>
				Plants	<i>Boechera crandallii</i>	Crandall's rock-cress	<input checked="" type="checkbox"/>
				Plants	<i>Penstemon fremontii</i> var. <i>glabrescens</i>	Fremont's beardtongue	<input type="checkbox"/>
				Plants	<i>Astragalus anisus</i>	Gunnison milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Thelypodopsis juniperorum</i>	Juniper tumble mustard	<input type="checkbox"/>
				Plants	<i>Oenothera acutissima</i>	Narrow-leaf evening primrose	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus naturitensis</i>	Naturita milkvetch	<input type="checkbox"/>
				Plants	<i>Penstemon scariosus</i> var. <i>cyanomontanus</i>	Plateau penstemon	<input type="checkbox"/>
				Plants	<i>Mertensia humilis</i>	Rocky Mountain bluebells	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus iodopetalus</i>	Violet milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Penstemon acaulis</i> var. <i>yampaensis</i>	Yampa beardtongue	<input checked="" type="checkbox"/>
				Reptiles	<i>Hypsiglena chlorophaea</i>	Desert nightsnake	<input type="checkbox"/>
				Reptiles	<i>Gambelia wislizenii</i>	Long-nosed leopard lizard	<input checked="" type="checkbox"/>
				Reptiles	<i>Rhinocheilus lecontei</i>	Long-nosed snake	<input type="checkbox"/>
				Reptiles	<i>Crotalus oreganus concolor</i>	Midget faded rattlesnake	<input type="checkbox"/>
				Reptiles	<i>Tantilla horbartsmithi</i>	Smith's black-headed snake	<input checked="" type="checkbox"/>

Table 8 - Continued.

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland, primarily pasture grasses, chaining	2.3 Habitat & Natural Process Restoration	Restore sagebrush using accepted techniques appropriate to site-specific conditions	H
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	H
03.1 Oil & Gas Drilling	Oil and gas drilling	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
04.2 Utility & Service Lines	Oil and gas pipelines	5.1 Legislation	Promote consideration of biodiversity issues in transportation and land use planning processes	H
07.3 Other Ecosystem Modifications	Altered native vegetation (juniper encroachment)	2.3 Habitat & Natural Process Restoration	Re-seed native species	H
07.3 Other Ecosystem Modifications	Altered native vegetation (low forb and grass diversity)	2.1 Site/Area Management	Implement compatible grazing practices	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
03.2 Mining & Quarrying	Coal mining	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
04.2 Utility & Service Lines	Overhead utility lines and towers	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
08.1 Invasive Non-Native/Alien Species	Invasive plants – cheatgrass	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	L

Table 8 - Continued.

Shrub

Saltbush

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Leucosticte australis</i>	Brown-capped rosy-finch	<input type="checkbox"/>	Birds	<i>Spizella breweri</i>	Brewer's sparrow	<input type="checkbox"/>
Birds	<i>Athene cunicularia</i>	Burrowing owl	<input type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
Birds	<i>Charadrius montanus</i>	Mountain plover	<input type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input type="checkbox"/>
Plants	<i>Aletes latilobus</i>	Canyonlands aletes	<input type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Plants	<i>Eriogonum pelinophilum</i>	Clay-loving wild buckwheat	<input checked="" type="checkbox"/>	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
Plants	<i>Sclerocactus glaucus</i>	Colorado hookless cactus	<input checked="" type="checkbox"/>	Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input type="checkbox"/>
Plants	<i>Lygodesmia doloresensis</i>	Dolores River skeletonplant	<input type="checkbox"/>	Mammals	<i>Vulpes macrotis</i>	Kit fox	<input checked="" type="checkbox"/>
Plants	<i>Sclerocactus mesae-verdae</i>	Mesa Verde hookless cactus	<input type="checkbox"/>	Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input type="checkbox"/>
Plants	<i>Astragalus tortipes</i>	Sleeping Ute milkvetch	<input checked="" type="checkbox"/>	Plants	<i>Cirsium perplexans</i>	Adobe thistle	<input type="checkbox"/>
Plants	<i>Penstemon scariosus var. albifluvis</i>	White River penstemon	<input type="checkbox"/>	Plants	<i>Calochortus ciscoensis</i>	Cisco sego lily	<input checked="" type="checkbox"/>
				Plants	<i>Eriogonum clavellatum</i>	Comb Wash buckwheat	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus cronquistii</i>	Cronquist milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus debequaeus</i>	DeBeque milkvetch	<input type="checkbox"/>
				Plants	<i>Camissonia eastwoodiae</i>	Eastwood evening primrose	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus piscator</i>	Fisher Towers milkvetch	<input type="checkbox"/>
				Plants	<i>Oreocarya revealii</i>	Gypsum Valley cat's-eye	<input checked="" type="checkbox"/>
				Plants	<i>Oreocarya osterhoutii</i>	Osterhout cat's-eye	<input type="checkbox"/>
				Plants	<i>Mentzelia paradoxensis</i>	Paradox stickleaf	<input checked="" type="checkbox"/>
				Reptiles	<i>Gambelia wislizenii</i>	Long-nosed leopard lizard	<input checked="" type="checkbox"/>
				Reptiles	<i>Crotalus oreganus concolor</i>	Midget faded rattlesnake	<input type="checkbox"/>
				Reptiles	<i>Tantilla horbartsmithi</i>	Smith's black-headed snake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation, erosion	2.3 Habitat & Natural Process Restoration	Implement Best Management Practices for livestock grazing	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	L
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	L
07.3 Other Ecosystem Modifications	Vegetation loss from a variety of sources, leading to erosion	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	L

Table 8 - Continued.

Shrub

Sandsage

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Athene cunicularia</i>	Burrowing owl	<input checked="" type="checkbox"/>	Birds	<i>Spizella breweri</i>	Brewer's sparrow	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Aimophila cassinii</i>	Cassin's sparrow	<input checked="" type="checkbox"/>
Birds	<i>Tympanuchus pallidicinctus</i>	Lesser prairie-chicken	<input checked="" type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Birds	<i>Tympanuchus phasianellus jamesi</i>	Plains sharp-tailed grouse	<input checked="" type="checkbox"/>	Birds	<i>Tympanuchus cupido</i>	Greater prairie-chicken	<input checked="" type="checkbox"/>
				Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
				Birds	<i>Numenius americanus</i>	Long-billed curlew	<input type="checkbox"/>
				Birds	<i>Colinus virginianus</i>	Northern bobwhite	<input checked="" type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Asio flammeus</i>	Short-eared owl	<input checked="" type="checkbox"/>
				Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
				Birds	<i>Bartramia longicauda</i>	Upland sandpiper	<input type="checkbox"/>
				Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input type="checkbox"/>
				Reptiles	<i>Rhinocheilus lecontei</i>	Long-nosed snake	<input checked="" type="checkbox"/>
				Reptiles	<i>Lampropeltis triangulum taylori</i>	Utah milksnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Kinosternon flavescens</i>	Yellow mud turtle	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	H
03.3 Renewable Energy	Disturbance, fragmentation, and loss of native habitat due to wind energy development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
01.1 Housing & Urban Areas	Urban, suburban, and exurban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
03.1 Oil & Gas Drilling	Disturbance, fragmentation, and loss of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
07.1 Fire & Fire Suppression	Altered native vegetation	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	L

Table 8 - Continued.

Shrub

Upland Shrub

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Leucosticte australis</i>	Brown-capped rosy-finch	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input type="checkbox"/>
Birds	<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	<input type="checkbox"/>	Birds	<i>Aimophila cassinii</i>	Cassin's sparrow	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Birds	<i>Selasphorus rufus</i>	Rufous hummingbird	<input checked="" type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Birds	<i>Asio flammeus</i>	Short-eared owl	<input checked="" type="checkbox"/>
				Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
				Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input checked="" type="checkbox"/>
				Insects	<i>Incisalia fotis</i>	Early elfin	<input checked="" type="checkbox"/>
				Insects	<i>Bombus morrisoni</i>	Morrison bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Callophrys mossii schryveri</i>	Moss's elfin	<input checked="" type="checkbox"/>
				Insects	<i>Erynnis martialis</i>	Mottled duskywing	<input checked="" type="checkbox"/>
				Insects	<i>Agapema homogena</i>	Rocky Mountain agapema	<input checked="" type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input checked="" type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input checked="" type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input type="checkbox"/>
				Plants	<i>Nuttallia densa</i>	Arkansas Canyon stickleaf	<input type="checkbox"/>
				Plants	<i>Draba smithii</i>	Smith whitlow-grass	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	M
06.1 Recreational Activities	Recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	L

Table 8 - Continued.

Grassland

Foothill and Mountain Grasslands

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	<input type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input checked="" type="checkbox"/>	Birds	<i>Dolichonyx oryzivorus</i>	Bobolink	<input checked="" type="checkbox"/>
Birds	<i>Grus canadensis tabida</i>	Greater sandhill crane	<input type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input checked="" type="checkbox"/>
Birds	<i>Charadrius montanus</i>	Mountain plover	<input type="checkbox"/>	Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input type="checkbox"/>
Mammals	<i>Mustela nigripes</i>	Black-footed ferret	<input type="checkbox"/>	Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
Mammals	<i>Cynomys gunnisoni</i>	Gunnison's prairie dog	<input checked="" type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Selasphorus rufus</i>	Rufous hummingbird	<input checked="" type="checkbox"/>
Mammals	<i>Perognathus fasciatus</i>	Olive-backed pocket mouse	<input checked="" type="checkbox"/>	Birds	<i>Asio flammeus</i>	Short-eared owl	<input checked="" type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
Mammals	<i>Cynomys leucurus</i>	White-tailed prairie dog	<input checked="" type="checkbox"/>	Insects	<i>Bombus pensylvanicus</i>	American bumblebee	<input checked="" type="checkbox"/>
Plants	<i>Ipomopsis polyantha</i>	Pagosa skyrocket	<input checked="" type="checkbox"/>	Insects	<i>Atrytone arogos</i>	Arogos skipper	<input checked="" type="checkbox"/>
				Insects	<i>Euphilotes rita coloradensis</i>	Colorado blue	<input checked="" type="checkbox"/>
				Insects	<i>Bombus morrisoni</i>	Morrison bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Erynnis martialis</i>	Mottled duskywing	<input type="checkbox"/>
				Insects	<i>Hesperia leonardus montana</i>	Pawnee montane skipper	<input type="checkbox"/>
				Insects	<i>Speyeria idalia</i>	Regal fritillary	<input type="checkbox"/>
				Insects	<i>Polites rhesus</i>	Rhesus skipper	<input type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Pyrgus xanthus</i>	Xanthus skipper	<input checked="" type="checkbox"/>
				Insects	<i>Bombus fervidus</i>	Yellow bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Proserpinus flavofasciata</i>	Yellow-banded day sphinx	<input checked="" type="checkbox"/>
				Mammals	<i>Ovis canadensis</i>	Bighorn sheep	<input type="checkbox"/>
				Mammals	<i>Bison bison</i>	Bison	<input checked="" type="checkbox"/>
				Mammals	<i>Thomomys bottae rubidus</i>	Botta's pocket gopher (rubidus ssp)	<input checked="" type="checkbox"/>
				Mammals	<i>Conepatus leuconotus</i>	Common hog-nosed skunk	<input type="checkbox"/>
				Mammals	<i>Canis lupus</i>	Gray wolf	<input type="checkbox"/>
				Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
				Mammals	<i>Sorex preblei</i>	Preble's shrew	<input type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input checked="" type="checkbox"/>
				Plants	<i>Eriogonum coloradense</i>	Colorado wild buckwheat	<input type="checkbox"/>
				Plants	<i>Penstemon degeneri</i>	Degener beardtongue	<input type="checkbox"/>
				Plants	<i>Penstemon mensarum</i>	Grand Mesa penstemon	<input type="checkbox"/>
				Plants	<i>Astragalus missouriensis var. humistratus</i>	Missouri milkvetch	<input type="checkbox"/>
				Plants	<i>Botrychium lineare</i>	Narrowleaf grape fern	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	H
01.3 Tourism & Recreation Areas	Trails and other open space infrastructure	2.1 Site/Area Management	Coordinate on ecologically sensitive design of recreational facilities	M
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
07.1 Fire & Fire Suppression	Altered native vegetation	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
08.1 Invasive Non-Native/Alien Species	Invasive or exotic species	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M

Table 8 - Continued.

11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L

Table 8 - Continued.

Grassland

Mixed and Tallgrass Prairies

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Athene cunicularia</i>	Burrowing owl	<input type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input checked="" type="checkbox"/>	Birds	<i>Dolichonyx oryzivorus</i>	Bobolink	<input checked="" type="checkbox"/>
Birds	<i>Tympanuchus pallidicinctus</i>	Lesser prairie-chicken	<input checked="" type="checkbox"/>	Birds	<i>Aimophila cassinii</i>	Cassin's sparrow	<input checked="" type="checkbox"/>
Birds	<i>Charadrius montanus</i>	Mountain plover	<input type="checkbox"/>	Birds	<i>Calcarius ornatus</i>	Chestnut-collared longspur	<input checked="" type="checkbox"/>
Birds	<i>Tympanuchus phasianellus jamesi</i>	Plains sharp-tailed grouse	<input type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input checked="" type="checkbox"/>
Mammals	<i>Mustela nigripes</i>	Black-footed ferret	<input type="checkbox"/>	Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input checked="" type="checkbox"/>
Mammals	<i>Perognathus fasciatus</i>	Olive-backed pocket mouse	<input checked="" type="checkbox"/>	Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
Reptiles	<i>Sistrurus catenatus</i>	Massasauga	<input checked="" type="checkbox"/>	Birds	<i>Numenius americanus</i>	Long-billed curlew	<input type="checkbox"/>
				Birds	<i>Colinus virginianus</i>	Northern bobwhite	<input type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Asio flammeus</i>	Short-eared owl	<input checked="" type="checkbox"/>
				Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
				Birds	<i>Bartramia longicauda</i>	Upland sandpiper	<input checked="" type="checkbox"/>
				Insects	<i>Bombus pennsylvanicus</i>	American bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Atrytone arogos</i>	Arogos skipper	<input type="checkbox"/>
				Insects	<i>Callophrys comstocki</i>	Comstock's hairstreak	<input type="checkbox"/>
				Insects	<i>Bombus morrisoni</i>	Morrison bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Hesperia ottoe</i>	Ottoe skipper	<input checked="" type="checkbox"/>
				Insects	<i>Speyeria idalia</i>	Regal fritillary	<input checked="" type="checkbox"/>
				Insects	<i>Polites rhesus</i>	Rhesus skipper	<input checked="" type="checkbox"/>
				Insects	<i>Bombus fraternus</i>	Southern plains bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus fervidus</i>	Yellow bumblebee	<input checked="" type="checkbox"/>
				Mammals	<i>Cynomys ludovicianus</i>	Black-tailed prairie dog	<input type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input checked="" type="checkbox"/>
				Reptiles	<i>Lampropeltis californiae</i>	California kingsnake	<input type="checkbox"/>
				Reptiles	<i>Phrynosoma cornutum</i>	Texas horned lizard	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.1 Site/Area Protection	Purchase habitat for conservation purpose	H
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	H
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
08.1 Invasive Non-Native/Alien Species	Noxious weeds	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
07.1 Fire & Fire Suppression	Altered fire regime, encroachment by woody plants	2.3 Habitat & Natural Process Restoration	Restore native prairie using site-specific techniques and context	L
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	8.0 Research & Monitoring	Research population parameters and/or monitor status	L

Table 8 - Continued.

Grassland

Shortgrass Prairie

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Athene cunicularia</i>	Burrowing owl	<input checked="" type="checkbox"/>	Amphibians	<i>Scaphiopus couchii</i>	Couch's spadefoot	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input checked="" type="checkbox"/>	Amphibians	<i>Anaxyrus debilis</i>	Green toad	<input type="checkbox"/>
Birds	<i>Charadrius montanus</i>	Mountain plover	<input checked="" type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input type="checkbox"/>
Mammals	<i>Mustela nigripes</i>	Black-footed ferret	<input checked="" type="checkbox"/>	Birds	<i>Aimophila cassinii</i>	Cassin's sparrow	<input checked="" type="checkbox"/>
Mammals	<i>Perognathus fasciatus</i>	Olive-backed pocket mouse	<input checked="" type="checkbox"/>	Birds	<i>Calcarius ornatus</i>	Chestnut-collared longspur	<input checked="" type="checkbox"/>
Reptiles	<i>Aspidoscelis neotesselata</i>	Colorado checkered whiptail	<input type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input checked="" type="checkbox"/>
Reptiles	<i>Sistrurus catenatus</i>	Massasauga	<input checked="" type="checkbox"/>	Birds	<i>Ammodramus savannarum</i>	Grasshopper sparrow	<input checked="" type="checkbox"/>
				Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input checked="" type="checkbox"/>
				Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input checked="" type="checkbox"/>
				Birds	<i>Numenius americanus</i>	Long-billed curlew	<input checked="" type="checkbox"/>
				Birds	<i>Rhynchophanes mccownii</i>	McCown's longspur	<input checked="" type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input checked="" type="checkbox"/>
				Birds	<i>Asio flammeus</i>	Short-eared owl	<input checked="" type="checkbox"/>
				Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
				Insects	<i>Bombus pensylvanicus</i>	American bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Euphilotes rita coloradensis</i>	Colorado blue	<input checked="" type="checkbox"/>
				Insects	<i>Danaus plexippus</i>	Monarch butterfly	<input checked="" type="checkbox"/>
				Insects	<i>Bombus morrisoni</i>	Morrison bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Eurystrymon favonius Ontario</i>	Northern hairstreak	<input type="checkbox"/>
				Insects	<i>Speyeria idalia</i>	Regal fritillary	<input checked="" type="checkbox"/>
				Insects	<i>Polites rhesus</i>	Rhesus skipper	<input checked="" type="checkbox"/>
				Insects	<i>Callophrys mcfarlandi</i>	Sandia hairstreak	<input checked="" type="checkbox"/>
				Insects	<i>Bombus fraternus</i>	Southern plains bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Euphyes bimacula</i>	Two-spotted skipper	<input type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Euproserpinus wiesti</i>	Wiest's sphinx moth	<input type="checkbox"/>
				Insects	<i>Bombus fervidus</i>	Yellow bumblebee	<input checked="" type="checkbox"/>
				Mammals	<i>Bison bison</i>	Bison	<input checked="" type="checkbox"/>
				Mammals	<i>Cynomys ludovicianus</i>	Black-tailed prairie dog	<input checked="" type="checkbox"/>
				Mammals	<i>Vulpes velox</i>	Swift fox	<input checked="" type="checkbox"/>
				Mammals	<i>Lepus townsendii</i>	White-tailed jackrabbit	<input checked="" type="checkbox"/>
				Plants	<i>Frasera coloradensis</i>	Colorado green gentian	<input checked="" type="checkbox"/>
				Plants	<i>Asclepias uncialis ssp. uncialis</i>	Dwarf milkweed	<input checked="" type="checkbox"/>
				Plants	<i>Oenopsis puebloensis</i>	Pueblo goldenweed	<input checked="" type="checkbox"/>
				Plants	<i>Oenopsis foliosa var. monocephala</i>	Rayless goldenweed	<input checked="" type="checkbox"/>
				Plants	<i>Trifolium dasyphyllum ssp. anemophilum</i>	Whip-root clover	<input checked="" type="checkbox"/>
				Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input type="checkbox"/>
				Reptiles	<i>Hypsiglena chlorophaea</i>	Desert nightsnake	<input type="checkbox"/>
				Reptiles	<i>Rhinocheilus lecontei</i>	Long-nosed snake	<input checked="" type="checkbox"/>
				Reptiles	<i>Rena dissectus</i>	New Mexico threadsnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Phrynosoma modestum</i>	Round-tailed horned lizard	<input checked="" type="checkbox"/>
				Reptiles	<i>Phrynosoma cornutum</i>	Texas horned lizard	<input checked="" type="checkbox"/>

Table 8 - Continued.

<div style="border: 1px solid black; padding: 2px; display: inline-block;"> Reptiles <i>Lampropeltis triangulum taylori</i> Utah milksnake <input checked="" type="checkbox"/> </div>				
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.3 Habitat & Natural Process Restoration	Restore native prairie using site-specific techniques and context	H
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
01.2 Commercial & Industrial Areas	Urban, suburban, and exurban development	5.2 Policies & Regulations	Promote zoning that concentrates use and protects habitat	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.1 Annual & Perennial Non-Timber Crops	Windbreaks, agricultural methods such as tilling, pitting	2.3 Habitat & Natural Process Restoration	Restore native prairie using site-specific techniques and context	M
04.1 Roads & Railroads	Roads or Railroads (super slab)	5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes	M
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts)	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	M
03.3 Renewable Energy	Wind energy development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development	L
07.1 Fire & Fire Suppression	Altered native vegetation (woody encroachment, seral stage imbalance, etc.)	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

Table 8 - Continued.
Riparian and Wetlands

Playas

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Birds	<i>Charadrius montanus</i>	Mountain plover	<input type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input type="checkbox"/>
Reptiles	<i>Aspidoscelis neotesselata</i>	Colorado checkered whiptail	<input checked="" type="checkbox"/>	Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input type="checkbox"/>
				Birds	<i>Sterna antillarum</i>	Least tern	<input checked="" type="checkbox"/>
				Birds	<i>Numenius americanus</i>	Long-billed curlew	<input checked="" type="checkbox"/>
				Birds	<i>Rhynchophanes mccownii</i>	McCown's longspur	<input type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
				Birds	<i>Charadrius melodus</i>	Piping plover	<input checked="" type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
				Birds	<i>Plegadis chihi</i>	White-faced ibis	<input checked="" type="checkbox"/>
				Plants	<i>Cleome multicaulis</i>	Slender spiderflower	<input type="checkbox"/>
				Reptiles	<i>Lampropeltis californiae</i>	California kingsnake	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	M
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	M
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling, eutrophication, siltation	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	M
09.3 Agricultural & Forestry Effluents	Fertilizer runoff, herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
01.1 Housing & Urban Areas	Urban, suburban, and exurban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - siltation and sedimentation	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	L
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	L
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	L

Table 8 - Continued.

Riparian and Wetlands

Riparian Woodlands and Shrublands

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	☑	Amphibians	<i>Lithobates blairi</i>	Plains leopard frog	☑
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	☑	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	☑
Birds	<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	☐	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	☑
Birds	<i>Lagopus leucura altipetens</i>	Southern white-tailed ptarmigan	☐	Birds	<i>Passerina amoena</i>	Lazuli bunting	☑
Birds	<i>Empidonax traillii extimus</i>	Southwestern willow flycatcher	☑	Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	☑
Birds	<i>Coccyzus americanus occidentalis</i>	Western yellow-billed cuckoo	☑	Birds	<i>Colinus virginianus</i>	Northern bobwhite	☑
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	☐	Birds	<i>Catharus fuscescens</i>	Veery	☑
Mammals	<i>Zapus hudsonius luteus</i>	New Mexico jumping mouse	☑	Insects	<i>Incisalia fotis</i>	Early elfin	☑
Mammals	<i>Zapus hudsonius preblei</i>	Prebles meadow jumping mouse	☑	Insects	<i>Speyeria nokomis nokomis</i>	Great Basin silverspot butterfly	☑
Plants	<i>Spiranthes diluvialis</i>	Ute ladies'-tresses	☑	Insects	<i>Capnia nelsoni</i>	Nelson's snowfly	☑
				Insects	<i>Bombus fraternus</i>	Southern plains bumblebee	☑
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	☑
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	☑
				Mammals	<i>Lasiurus cinereus</i>	Hoary bat	☑
				Mammals	<i>Lepus americanus</i>	Snowshoe hare	☑
				Reptiles	<i>Thamnophis sirtalis</i>	Common gartersnake	☑

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	H
03.2 Mining & Quarrying	Gravel mining	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
07.2 Dams & Water Management/Use	Altered hydrological regime (dams and diversions)	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
07.2 Dams & Water Management/Use	Channelization	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	H
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk and Russian olive	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
01.2 Commercial & Industrial Areas	Development along major stream corridors	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	M
02.1 Annual & Perennial Non-Timber Crops	Conversion or altered vegetation for hay making	2.3 Habitat & Natural Process Restoration	Restore riparian vegetation using site-specific techniques and context	M
04.1 Roads & Railroads	Fragmentation (roads)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects	M
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	M
09.1 Household Sewage & Urban Waste Water	Water pollution, fertilizer runoff	5.4 Compliance & Enforcement	Enforce state/federal/local pollution standards	L
09.3 Agricultural & Forestry Effluents	Fertilizer runoff, herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	L

Table 8 - Continued.
Riparian and Wetlands

Wetlands

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	<input checked="" type="checkbox"/>	Amphibians	<i>Acris crepitans</i>	Blanchard's cricket frog	<input type="checkbox"/>
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Amphibians	<i>Scaphiopus couchii</i>	Couch's spadefoot	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Amphibians	<i>Gastrophryne olivacea</i>	Great Plains narrowmouth toad	<input checked="" type="checkbox"/>
Birds	<i>Grus canadensis tabida</i>	Greater sandhill crane	<input checked="" type="checkbox"/>	Amphibians	<i>Lithobates blairi</i>	Plains leopard frog	<input checked="" type="checkbox"/>
Birds	<i>Lagopus leucura altipetens</i>	Southern white-tailed ptarmigan	<input type="checkbox"/>	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	<input checked="" type="checkbox"/>
Plants	<i>Mimulus gemmiparus</i>	Budding monkey flower	<input type="checkbox"/>	Birds	<i>Botaurus lentiginosus</i>	American bittern	<input checked="" type="checkbox"/>
Plants	<i>Oenothera coloradensis ssp. coloradensis</i>	Colorado butterfly plant	<input checked="" type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Plants	<i>Eutrema penlandii</i>	Penland alpine fen mustard	<input checked="" type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input type="checkbox"/>
				Birds	<i>Bucephala islandica</i>	Barrow's goldeneye	<input checked="" type="checkbox"/>
				Birds	<i>Chlidonias niger</i>	Black tern	<input checked="" type="checkbox"/>
				Birds	<i>Numenius americanus</i>	Long-billed curlew	<input type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
				Birds	<i>Charadrius melodus</i>	Piping plover	<input type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Asio flammeus</i>	Short-eared owl	<input checked="" type="checkbox"/>
				Birds	<i>Plegadis chihi</i>	White-faced ibis	<input checked="" type="checkbox"/>
				Birds	<i>Grus americana</i>	Whooping crane	<input checked="" type="checkbox"/>
				Insects	<i>Ochrotrichia trapoiza</i>	Caddisfly	<input type="checkbox"/>
				Insects	<i>Epitheca petechialis</i>	Dot-winged baskettail	<input checked="" type="checkbox"/>
				Insects	<i>Speyeria nokomis nokomis</i>	Great Basin silverspot butterfly	<input checked="" type="checkbox"/>
				Insects	<i>Libellula nodisticta</i>	Hoary skimmer	<input checked="" type="checkbox"/>
				Insects	<i>Somatochlora hudsonica</i>	Hudsonian emerald	<input checked="" type="checkbox"/>
				Insects	<i>Danaus plexippus</i>	Monarch butterfly	<input checked="" type="checkbox"/>
				Insects	<i>Capnia nelsoni</i>	Nelson's snowfly	<input type="checkbox"/>
				Insects	<i>Sympetrum madidum</i>	Red-veined meadowfly	<input checked="" type="checkbox"/>
				Insects	<i>Speyeria idalia</i>	Regal fritillary	<input type="checkbox"/>
				Insects	<i>Bombus fraternus</i>	Southern plains bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Ochrotrichia susanae</i>	Susan's purse-making caddisfly	<input checked="" type="checkbox"/>
				Insects	<i>Euphyes bimacula</i>	Two-spotted skipper	<input checked="" type="checkbox"/>
				Insects	<i>Boloria improba acrocneuma</i>	Uncompahgre fritillary	<input type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Mammals	<i>Sorex hoyi montanus</i>	Pygmy shrew	<input checked="" type="checkbox"/>
				Mammals	<i>Lontra canadensis</i>	River otter	<input type="checkbox"/>
				Mammals	<i>Lepus americanus</i>	Snowshoe hare	<input type="checkbox"/>
				Mollusks	<i>Promenetus umbilicatellus</i>	Cockerell	<input type="checkbox"/>
				Mollusks	<i>Promenetus exacuouus</i>	Sharp sprite	<input type="checkbox"/>
				Plants	<i>Limnorchis zothecina</i>	Alcove bog orchid	<input type="checkbox"/>
				Plants	<i>Anticlea vaginatus</i>	Alcove death camas	<input type="checkbox"/>
				Plants	<i>Salix arizonica</i>	Arizona willow	<input checked="" type="checkbox"/>
				Plants	<i>Oenothera acutissima</i>	Narrow-leaf evening primrose	<input type="checkbox"/>
				Plants	<i>Thelypodium paniculatum</i>	Northwestern thelypod	<input checked="" type="checkbox"/>
				Plants	<i>Puccinellia parishii</i>	Parish's alkali grass	<input checked="" type="checkbox"/>
				Plants	<i>Ptilagrostis porteri</i>	Porter feathergrass	<input checked="" type="checkbox"/>
				Plants	<i>Cleome multicaulis</i>	Slender spiderflower	<input checked="" type="checkbox"/>
				Reptiles	<i>Thamnophis sirtalis</i>	Common gartersnake	<input checked="" type="checkbox"/>

Table 8 - Continued.

<div style="display: flex; justify-content: space-between; align-items: center; border: 1px solid black; padding: 2px;"> Reptiles <i>Kinosternon flavescens</i> Yellow mud turtle </div>				
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	H
01.3 Tourism & Recreation Areas	Roads and trails	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to pasture grass or other altered vegetation	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	H
02.3 Livestock Farming & Ranching	Altered native vegetation (grazing intensity)	2.1 Site/Area Management	Implement compatible grazing practices	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer) - altered flow and fluctuating water temperatures	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	H
11.2 Droughts	Lack of water due to drought and exacerbated by climate change	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
09.3 Agricultural & Forestry Effluents	Fertilizer runoff, herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Identify and control point-source and non-point source pollution	M
04.1 Roads & Railroads	Fragmentation	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects	L

Table 8 - Continued.

Aquatic

Colorado Plateau - Wyoming Basins Rivers

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Amphibians	<i>Hyla arenicolor</i>	Canyon tree frog	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Birds	<i>Grus canadensis tabida</i>	Greater sandhill crane	<input type="checkbox"/>	Birds	<i>Pelecanus erythrorhynchos</i>	American white pelican	<input type="checkbox"/>
Fish	<i>Catostomus discobolus</i>	Bluehead sucker	<input checked="" type="checkbox"/>	Birds	<i>Bucephala islandica</i>	Barrow's goldeneye	<input type="checkbox"/>
Fish	<i>Gila elegans</i>	Bonytail chub	<input checked="" type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input type="checkbox"/>
Fish	<i>Ptychocheilus lucius</i>	Colorado pikeminnow	<input checked="" type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Fish	<i>Catostomus latipinnis</i>	Flannelmouth sucker	<input checked="" type="checkbox"/>	Birds	<i>Progne subis</i>	Purple martin	<input type="checkbox"/>
Fish	<i>Gila cypha</i>	Humpback chub	<input checked="" type="checkbox"/>	Birds	<i>Plegadis chihi</i>	White-faced ibis	<input checked="" type="checkbox"/>
Fish	<i>Catostomus platyrhynchus</i>	Mountain sucker	<input checked="" type="checkbox"/>	Insects	<i>Stylurus intricatus</i>	Brimstone clubtail	<input checked="" type="checkbox"/>
Fish	<i>Xyrauchen texanus</i>	Razorback sucker	<input checked="" type="checkbox"/>	Insects	<i>Lachlania saskatchewanensis</i>	Bushlegged mayfly	<input type="checkbox"/>
Fish	<i>Gila robusta</i>	Roundtail chub	<input checked="" type="checkbox"/>	Insects	<i>Ametropus neavei</i>	Mayfly, spp.	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Mammals	<i>Lontra canadensis</i>	River otter	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Mollusks	<i>Ferrissia walkeri</i>	Cloche ancyloid	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallascens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Mollusks	<i>Ferrissia fragilis</i>	Fragil ancyloid	<input type="checkbox"/>
				Mollusks	<i>Promenetus exacuouus</i>	Sharp sprite	<input type="checkbox"/>
				Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	H
07.2 Dams & Water Management/Use	Altered hydrological regime	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using accepted integrated pest management techniques for aquatic habitats	H
01.3 Tourism & Recreation Areas	Recreation area developments	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
02.1 Annual & Perennial Non-Timber Crops	Irrigated tilled and untilled crops	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	L
02.3 Livestock Farming & Ranching	Domestic livestock grazing	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	L

Table 8 - Continued.

Aquatic

Colorado Plateau - Wyoming Basins Streams

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Amphibians	<i>Hyla arenicolor</i>	Canyon tree frog	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Birds	<i>Centrocercus urophasianus</i>	Greater sage-grouse	<input type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input checked="" type="checkbox"/>
Fish	<i>Catostomus discobolus</i>	Bluehead sucker	<input checked="" type="checkbox"/>	Birds	<i>Bucephala islandica</i>	Barrow's goldeneye	<input type="checkbox"/>
Fish	<i>Oncorhynchus clarkii pleuriticus</i>	Colorado River cutthroat trout	<input type="checkbox"/>	Birds	<i>Cypseloides niger</i>	Black swift	<input checked="" type="checkbox"/>
Fish	<i>Catostomus latipinnis</i>	Flannelmouth sucker	<input checked="" type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input type="checkbox"/>
Fish	<i>Catostomus platyrhynchus</i>	Mountain sucker	<input checked="" type="checkbox"/>	Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	<input checked="" type="checkbox"/>
Fish	<i>Gila robusta</i>	Roundtail chub	<input type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input type="checkbox"/>	Insects	<i>Speyeria nokomis nokomis</i>	Great Basin silverspot butterfly	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input type="checkbox"/>	Insects	<i>Libellula nodisticta</i>	Hoary skimmer	<input checked="" type="checkbox"/>
				Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input type="checkbox"/>
				Mammals	<i>Lontra canadensis</i>	River otter	<input type="checkbox"/>
				Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Altered hydrological regime (surface or aquifer)	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	H
07.2 Dams & Water Management/Use	Altered hydrological regime	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
08.1 Invasive Non-Native/Alien Species	Non-native fish	2.2 Invasive/Problematic Species Control	Control non-native fish using accepted integrated pest management techniques for aquatic habitats	H
01.3 Tourism & Recreation Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
02.1 Annual & Perennial Non-Timber Crops	Irrigated hay meadows	2.3 Habitat & Natural Process Restoration	Restore native habitat	L

Table 8 - Continued.

Aquatic

Eastern Plains Rivers

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Amphibians	<i>Acris crepitans</i>	Blanchard's cricket frog	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Amphibians	<i>Lithobates blairi</i>	Plains leopard frog	<input checked="" type="checkbox"/>
Fish	<i>Etheostoma cragini</i>	Arkansas darter	<input type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Fish	<i>Hybognathus hankinsoni</i>	Brassy minnow	<input type="checkbox"/>	Birds	<i>Pelecanus erythrorhynchos</i>	American white pelican	<input type="checkbox"/>
Fish	<i>Platygobio gracilis</i>	Flathead chub	<input checked="" type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input checked="" type="checkbox"/>
Fish	<i>Lepomis humilis</i>	Orangespotted sunfish	<input checked="" type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input type="checkbox"/>
Fish	<i>Etheostoma spectabile</i>	Orangethroat darter	<input type="checkbox"/>	Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	<input checked="" type="checkbox"/>
Fish	<i>Hybognathus placitus</i>	Plains minnow	<input checked="" type="checkbox"/>	Birds	<i>Numenius americanus</i>	Long-billed curlew	<input type="checkbox"/>
Fish	<i>Fundulus sciadicus</i>	Plains topminnow	<input checked="" type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
Fish	<i>Noturus flavus</i>	Stonecat	<input type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Fish	<i>Phenacobius mirabilis</i>	Suckermouth minnow	<input checked="" type="checkbox"/>	Fish	<i>Etheostoma exile</i>	Iowa darter	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Insects	<i>Lachlania saskatchewanensis</i>	Bushlegged mayfly	<input type="checkbox"/>
Mammals	<i>Zapus hudsonius luteus</i>	New Mexico jumping mouse	<input type="checkbox"/>	Insects	<i>Epithea petechialis</i>	Dot-winged baskettail	<input type="checkbox"/>
Mammals	<i>Zapus hudsonius preblei</i>	Prebles meadow jumping mouse	<input type="checkbox"/>	Insects	<i>Argia alberta</i>	Paiute dancer	<input checked="" type="checkbox"/>
				Insects	<i>Mesocapnia frisoni</i>	Plains snowfly	<input type="checkbox"/>
				Mammals	<i>Lontra canadensis</i>	River otter	<input type="checkbox"/>
				Mollusks	<i>Ferrissia fragilis</i>	Fragil ancyliid	<input checked="" type="checkbox"/>
				Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Thamnophis sirtalis</i>	Common gartersnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Rhinocheilus lecontei</i>	Long-nosed snake	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime (aquifer)	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface)	2.3 Habitat & Natural Process Restoration	Restore native habitat using site-specific techniques and context	H
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration	Collaborate with relevant agencies and stakeholders to adjust operation of dam	H
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk and Russian olive	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
09.2 Industrial & Military Effluents	Mining and energy production	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
01.1 Housing & Urban Areas	Urban & exurban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.	L
02.1 Annual & Perennial Non-Timber Crops	Consumptive use for irrigation	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	L

Table 8 - Continued.

Aquatic

Eastern Plains Streams

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Amphibians	<i>Acris crepitans</i>	Blanchard's cricket frog	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Amphibians	<i>Gastrophryne olivacea</i>	Great Plains narrowmouth toad	<input checked="" type="checkbox"/>
Fish	<i>Etheostoma cragini</i>	Arkansas darter	<input checked="" type="checkbox"/>	Amphibians	<i>Anaxyrus debilis</i>	Green toad	<input checked="" type="checkbox"/>
Fish	<i>Hybognathus hankinsoni</i>	Brassy minnow	<input checked="" type="checkbox"/>	Amphibians	<i>Lithobates blairi</i>	Plains leopard frog	<input checked="" type="checkbox"/>
Fish	<i>Platygobio gracilis</i>	Flathead chub	<input checked="" type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Fish	<i>Lepomis humilis</i>	Orangespotted sunfish	<input checked="" type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input checked="" type="checkbox"/>
Fish	<i>Etheostoma spectabile</i>	Orangethroat darter	<input checked="" type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input type="checkbox"/>
Fish	<i>Hybognathus placitus</i>	Plains minnow	<input type="checkbox"/>	Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	<input checked="" type="checkbox"/>
Fish	<i>Fundulus sciadicus</i>	Plains topminnow	<input checked="" type="checkbox"/>	Birds	<i>Numenius americanus</i>	Long-billed curlew	<input type="checkbox"/>
Fish	<i>Chrosomus erythrogaster</i>	Southern redbelly dace	<input type="checkbox"/>	Birds	<i>Colinus virginianus</i>	Northern bobwhite	<input type="checkbox"/>
Fish	<i>Noturus flavus</i>	Stonecat	<input checked="" type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
Fish	<i>Phenacobius mirabilis</i>	Suckermouth minnow	<input checked="" type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
Mammals	<i>Zapus hudsonius luteus</i>	New Mexico jumping mouse	<input checked="" type="checkbox"/>	Fish	<i>Etheostoma exile</i>	Iowa darter	<input checked="" type="checkbox"/>
Mammals	<i>Zapus hudsonius preblei</i>	Prebles meadow jumping mouse	<input checked="" type="checkbox"/>	Insects	<i>Epithea petechialis</i>	Dot-winged baskettail	<input type="checkbox"/>
				Insects	<i>Libellula nodisticta</i>	Hoary skimmer	<input checked="" type="checkbox"/>
				Insects	<i>Somatochlora ensigera</i>	Lemon-faced emerald	<input checked="" type="checkbox"/>
				Insects	<i>Argia alberta</i>	Paiute dancer	<input checked="" type="checkbox"/>
				Insects	<i>Mesocapnia frisoni</i>	Plains snowfly	<input type="checkbox"/>
				Insects	<i>Neochoroterpes oklahoma</i>	Prongbill mayfly	<input type="checkbox"/>
				Insects	<i>Euphyes bimacula</i>	Two-spotted skipper	<input checked="" type="checkbox"/>
				Mammals	<i>Lontra canadensis</i>	River otter	<input type="checkbox"/>
				Mollusks	<i>Anodontooides ferussacianus</i>	Cylindrical papershell	<input checked="" type="checkbox"/>
				Mollusks	<i>Ferrissia fragilis</i>	Fragil ancyloid	<input checked="" type="checkbox"/>
				Mollusks	<i>Unio merus tetralasmus</i>	Pondhorn	<input checked="" type="checkbox"/>
				Reptiles	<i>Thamnophis cyrtopsis</i>	Blacknecked gartersnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Thamnophis sirtalis</i>	Common gartersnake	<input checked="" type="checkbox"/>
				Reptiles	<i>Hypsiglena chlorophaea</i>	Desert nightsnake	<input type="checkbox"/>
				Reptiles	<i>Rena dissectus</i>	New Mexico threadsnake	<input type="checkbox"/>
				Reptiles	<i>Kinosternon flavescens</i>	Yellow mud turtle	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Incompatible grazing	2.1 Site/Area Management	Implement compatible grazing practices	H
07.2 Dams & Water Management/Use	Altered hydrological regime (aquifer)	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface)	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
02.1 Annual & Perennial Non-Timber Crops	Irrigation	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	M
08.1 Invasive Non-Native/Alien Species	Invasive plants - tamarisk and Russian olive	2.2 Invasive/Problematic Species Control	Write and/or implement integrated weed/pest management plan	M
09.3 Agricultural & Forestry Effluents	Fertilizer runoff, herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
01.1 Housing & Urban Areas	Habitat fragmentation	5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.	L

Table 8 - Continued.

Aquatic

Lakes

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	<input checked="" type="checkbox"/>	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	<input checked="" type="checkbox"/>
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Birds	<i>Bucephala islandica</i>	Barrow's goldeneye	<input checked="" type="checkbox"/>
Fish	<i>Oncorhynchus clarkii pleuriticus</i>	Colorado River cutthroat trout	<input checked="" type="checkbox"/>	Birds	<i>Plegadis chihi</i>	White-faced ibis	<input checked="" type="checkbox"/>
Fish	<i>Catostomus latipinnis</i>	Flannelmouth sucker	<input type="checkbox"/>	Fish	<i>Couesius plumbeus</i>	Lake chub	<input checked="" type="checkbox"/>
Fish	<i>Oncorhynchus clarkii stomias</i>	Greenback cutthroat trout	<input checked="" type="checkbox"/>	Insects	<i>Libellula nodisticta</i>	Hoary skimmer	<input checked="" type="checkbox"/>
Fish	<i>Chrosomus eos</i>	Northern redbelly dace	<input type="checkbox"/>	Insects	<i>Sympetrum madidum</i>	Red-veined meadowfly	<input checked="" type="checkbox"/>
Fish	<i>Lepomis humilis</i>	Orangespotted sunfish	<input type="checkbox"/>	Mollusks	<i>Ferrissia walkeri</i>	Cloche ancyloid	<input checked="" type="checkbox"/>
Fish	<i>Gila pandora</i>	Rio Grande chub	<input type="checkbox"/>	Mollusks	<i>Promenetus umbilicatellus</i>	Cockerell	<input checked="" type="checkbox"/>
Fish	<i>Oncorhynchus clarkii virginalis</i>	Rio Grande cutthroat trout	<input checked="" type="checkbox"/>	Mollusks	<i>Anodontoides ferussacianus</i>	Cylindrical papershell	<input checked="" type="checkbox"/>
Fish	<i>Chrosomus erythrogaster</i>	Southern redbelly dace	<input type="checkbox"/>	Mollusks	<i>Ferrissia fragilis</i>	Fragil ancyloid	<input type="checkbox"/>
				Mollusks	<i>Uniomereus tetralasmus</i>	Pondhorn	<input checked="" type="checkbox"/>
				Mollusks	<i>Acroloxus coloradensis</i>	Rocky Mountain capshell	<input checked="" type="checkbox"/>
				Mollusks	<i>Promenetus exacuouus</i>	Sharp sprite	<input checked="" type="checkbox"/>
				Mollusks	<i>Physa gyrina utahensis</i>	Utah physa	<input checked="" type="checkbox"/>
				Reptiles	<i>Kinosternon flavescens</i>	Yellow mud turtle	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
09.3 Agricultural & Forestry Effluents	Fertilizer runoff, herbicide/pesticide spraying or runoff	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects, urban development, landscaping, etc..	M
09.3 Agricultural & Forestry Effluents	Nutrient loads	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M
01.3 Tourism & Recreation Areas	Recreational infrastructure development	2.1 Site/Area Management	Coordinate on ecologically sensitive design of recreational facilities	L
06.1 Recreational Activities	Recreational use that disturbs species of concern	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
09.5 Air-Borne Pollutants	Excess nitrogen deposition	5.4 Compliance & Enforcement	Enforce state/federal/local pollution standards	L

Table 8 - Continued.

Aquatic

Mountain Streams

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain Population)	<input checked="" type="checkbox"/>	Amphibians	<i>Lithobates sylvatica</i>	Wood frog	<input checked="" type="checkbox"/>
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input type="checkbox"/>
Birds	<i>Grus canadensis tabida</i>	Greater sandhill crane	<input type="checkbox"/>	Birds	<i>Bucephala islandica</i>	Barrow's goldeneye	<input type="checkbox"/>
Fish	<i>Oncorhynchus clarkii pleuriticus</i>	Colorado River cutthroat trout	<input checked="" type="checkbox"/>	Birds	<i>Cypseloides niger</i>	Black swift	<input checked="" type="checkbox"/>
Fish	<i>Oncorhynchus clarkii stomias</i>	Greenback cutthroat trout	<input checked="" type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input type="checkbox"/>
Fish	<i>Catostomus platyrhynchus</i>	Mountain sucker	<input type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Fish	<i>Gila pandora</i>	Rio Grande chub	<input type="checkbox"/>	Birds	<i>Progne subis</i>	Purple martin	<input type="checkbox"/>
Fish	<i>Oncorhynchus clarkii virginalis</i>	Rio Grande cutthroat trout	<input checked="" type="checkbox"/>	Insects	<i>Arsapnia arapahoe</i>	Arapahoe snowfly	<input checked="" type="checkbox"/>
Fish	<i>Catostomus plebeius</i>	Rio Grande sucker	<input checked="" type="checkbox"/>	Insects	<i>Baetis brunneicolor</i>	Small minnow mayfly	<input type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Mammals	<i>Ursus arctos</i>	Grizzly bear	<input type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Mammals	<i>Lontra canadensis</i>	River otter	<input checked="" type="checkbox"/>
Mammals	<i>Zapus hudsonius luteus</i>	New Mexico jumping mouse	<input checked="" type="checkbox"/>	Mollusks	<i>Promenetus umbillicatellus</i>	Cockerell	<input type="checkbox"/>
Mammals	<i>Zapus hudsonius preblei</i>	Prebles meadow jumping mouse	<input checked="" type="checkbox"/>	Mollusks	<i>Acroloxus coloradensis</i>	Rocky Mountain capshell	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat	<input type="checkbox"/>	Mollusks	<i>Promenetus exacuous</i>	Sharp sprite	<input type="checkbox"/>
Plants	<i>Draba weberi</i>	Weber's draba	<input checked="" type="checkbox"/>				

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
08.1 Invasive Non-Native/Alien Species	Invasive animals	2.2 Invasive/Problematic Species Control	Control non-native fish using accepted integrated pest management techniques for aquatic habitats	M

Aquatic

Reservoirs and Shorelines

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Pelecanus erythrorhynchos</i>	American white pelican	<input checked="" type="checkbox"/>	Birds	<i>Sterna antillarum</i>	Least tern	<input checked="" type="checkbox"/>
Birds	<i>Charadrius melodus</i>	Piping plover	<input checked="" type="checkbox"/>	Birds	<i>Charadrius alexandrinus nivosus</i>	Western snowy plover	<input checked="" type="checkbox"/>
Birds	<i>Plegadis chihi</i>	White-faced ibis	<input checked="" type="checkbox"/>	Birds	<i>Plegadis chihi</i>	White-faced ibis	<input checked="" type="checkbox"/>
Insects	<i>Bombus fraternus</i>	Southern plains bumblebee	<input checked="" type="checkbox"/>	Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>	Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
Mollusks	<i>Ferrissia walkeri</i>	Cloche ancyliid	<input type="checkbox"/>	Mollusks	<i>Ferrissia fragilis</i>	Fragil ancyliid	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.3 Tourism & Recreation Areas		2.1 Site/Area Management	Coordinate on ecologically sensitive design of recreational facilities	M
06.1 Recreational Activities		2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M

Table 8 - Continued.**Aquatic****Rio Grande Valley Rivers**

Tier 1 Species				Tier 2 Species	
Group	Species	Common Name	Primary		
Fish	<i>Gila pandora</i>	Rio Grande chub	<input checked="" type="checkbox"/>		
Fish	<i>Catostomus plebeius</i>	Rio Grande sucker	<input checked="" type="checkbox"/>		
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority	
07.2 Dams & Water Management/Use	Altered hydrological regime	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H	
11.1 Habitat Shifting & Alteration	Altered flows, temperature, and other habitat characteristics related to changing temperature and precipitation regimes	8.0 Research & Monitoring	Prepare climate change adaptation strategy to identify and address barriers to species movement and habitat shifting	H	
02.1 Annual & Perennial Non-Timber Crops	consumptive water use	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	M	
01.1 Housing & Urban Areas	consumptive water use	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	L	

Aquatic**Rio Grande Valley Streams**

Tier 1 Species				Tier 2 Species	
Group	Species	Common Name	Primary		
Fish	<i>Gila pandora</i>	Rio Grande chub	<input checked="" type="checkbox"/>		
Fish	<i>Catostomus plebeius</i>	Rio Grande sucker	<input checked="" type="checkbox"/>		
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority	
07.2 Dams & Water Management/Use	Altered hydrological regime	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H	
11.1 Habitat Shifting & Alteration	Altered flows, temperature, and other habitat characteristics related to changing temperature and precipitation regimes	8.0 Research & Monitoring	Prepare climate change adaptation strategy to identify and address barriers to species movement and habitat shifting	H	
02.1 Annual & Perennial Non-Timber Crops	consumptive water use	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	M	
01.1 Housing & Urban Areas	consumptive water use	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	L	

Table 8 - Continued.

Aquatic

Transition Streams

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Amphibians	<i>Lithobates pipiens</i>	Northern leopard frog	<input checked="" type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input checked="" type="checkbox"/>
Fish	<i>Etheostoma cragini</i>	Arkansas darter	<input type="checkbox"/>	Birds	<i>Passerina amoena</i>	Lazuli bunting	<input type="checkbox"/>
Fish	<i>Hybognathus hankinsoni</i>	Brassy minnow	<input checked="" type="checkbox"/>	Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	<input checked="" type="checkbox"/>
Fish	<i>Luxilus cornutus</i>	Common shiner	<input checked="" type="checkbox"/>	Birds	<i>Strix occidentalis lucida</i>	Mexican spotted owl	<input checked="" type="checkbox"/>
Fish	<i>Platygobio gracilis</i>	Flathead chub	<input checked="" type="checkbox"/>	Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
Fish	<i>Chrosomus eos</i>	Northern redbelly dace	<input checked="" type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Fish	<i>Lepomis humilis</i>	Orangespotted sunfish	<input type="checkbox"/>	Birds	<i>Oreothlypis virginiae</i>	Virginia's warbler	<input type="checkbox"/>
Fish	<i>Etheostoma spectabile</i>	Orangethroat darter	<input type="checkbox"/>	Fish	<i>Etheostoma exile</i>	Iowa darter	<input checked="" type="checkbox"/>
Fish	<i>Fundulus sciadicus</i>	Plains topminnow	<input checked="" type="checkbox"/>	Insects	<i>Arsapnia arapahoe</i>	Arapahoe snowfly	<input type="checkbox"/>
Fish	<i>Chrosomus erythrogaster</i>	Southern redbelly dace	<input checked="" type="checkbox"/>	Insects	<i>Celastrina humulus</i>	Hops feeding azure	<input checked="" type="checkbox"/>
Fish	<i>Noturus flavus</i>	Stonecat	<input checked="" type="checkbox"/>	Insects	<i>Callophrys mossii schryveri</i>	Moss's elfin	<input type="checkbox"/>
Fish	<i>Phenacobius mirabilis</i>	Suckermouth minnow	<input type="checkbox"/>	Insects	<i>Mesocapnia frisoni</i>	Plains snowfly	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input type="checkbox"/>	Mammals	<i>Lontra canadensis</i>	River otter	<input type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Mollusks	<i>Physa gyrina utahensis</i>	Utah physa	<input checked="" type="checkbox"/>
Mammals	<i>Zapus hudsonius luteus</i>	New Mexico jumping mouse	<input type="checkbox"/>				
Mammals	<i>Zapus hudsonius preblei</i>	Prebles meadow jumping mouse	<input checked="" type="checkbox"/>				
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat	<input type="checkbox"/>				

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Altered hydrological regime	2.3 Habitat & Natural Process Restoration	Restore or maintain suitable hydrological regime	H
11.1 Habitat Shifting & Alteration	Altered flows, temperature, and other habitat characteristics related to changing temperature and precipitation regimes	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	H
01.1 Housing & Urban Areas	Altered hydrological regime	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	L

Table 8 - Continued.

Other

Agriculture

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	<input type="checkbox"/>	Birds	<i>Haliaeetus leucocephalus</i>	Bald eagle	<input type="checkbox"/>
Birds	<i>Centrocercus urophasianus</i>	Greater sage-grouse	<input type="checkbox"/>	Birds	<i>Patagioenas fasciata</i>	Band-tailed pigeon	<input type="checkbox"/>
Birds	<i>Grus canadensis tabida</i>	Greater sandhill crane	<input checked="" type="checkbox"/>	Birds	<i>Dolichonyx oryzivorus</i>	Bobolink	<input checked="" type="checkbox"/>
Birds	<i>Centrocercus minimus</i>	Gunnison sage-grouse	<input type="checkbox"/>	Birds	<i>Spizella breweri</i>	Brewer's sparrow	<input type="checkbox"/>
Birds	<i>Tympanuchus pallidicinctus</i>	Lesser prairie-chicken	<input type="checkbox"/>	Birds	<i>Aimophila cassinii</i>	Cassin's sparrow	<input type="checkbox"/>
Birds	<i>Charadrius montanus</i>	Mountain plover	<input type="checkbox"/>	Birds	<i>Calcarius ornatus</i>	Chestnut-collared longspur	<input type="checkbox"/>
				Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
				Birds	<i>Tympanuchus cupido</i>	Greater prairie-chicken	<input checked="" type="checkbox"/>
				Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input checked="" type="checkbox"/>
				Birds	<i>Melanerpes lewis</i>	Lewis's woodpecker	<input type="checkbox"/>
				Birds	<i>Lanius ludovicianus</i>	Loggerhead shrike	<input type="checkbox"/>
				Birds	<i>Numenius americanus</i>	Long-billed curlew	<input type="checkbox"/>
				Birds	<i>Rhynchophanes mccownii</i>	McCown's longspur	<input type="checkbox"/>
				Birds	<i>Colinus virginianus</i>	Northern bobwhite	<input checked="" type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input checked="" type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Asio flammeus</i>	Short-eared owl	<input type="checkbox"/>
				Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input checked="" type="checkbox"/>
				Birds	<i>Bartramia longicauda</i>	Upland sandpiper	<input type="checkbox"/>
				Birds	<i>Plegadis chihi</i>	White-faced ibis	<input checked="" type="checkbox"/>
				Birds	<i>Grus americana</i>	Whooping crane	<input checked="" type="checkbox"/>
				Insects	<i>Bombus pensylvanicus</i>	American bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Danaus plexippus</i>	Monarch butterfly	<input checked="" type="checkbox"/>
				Insects	<i>Bombus fraternus</i>	Southern plains bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
				Insects	<i>Bombus fervidus</i>	Yellow bumblebee	<input checked="" type="checkbox"/>
				Mammals	<i>Vulpes velox</i>	Swift fox	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Lack of plant and structural diversity within fields and within landscapes	2.1 Site/Area Management	Encourage multi-species cover crops in annual farming operations	H
02.1 Annual & Perennial Non-Timber Crops	Lack of plant and structural diversity within fields and within landscapes	2.1 Site/Area Management	Plant marginally productive cropland to permanent wildlife cover	H
02.1 Annual & Perennial Non-Timber Crops	Loss of habitat from agricultural dewatering	1.2 Resource & Habitat Protection	Use conservation easements or co-op agreements to secure water rights in key areas	H
02.1 Annual & Perennial Non-Timber Crops	Direct mortality caused by harvest operations	2.1 Site/Area Management	Encourage delayed harvest until after bird nesting	M
02.1 Annual & Perennial Non-Timber Crops	Direct mortality caused by harvest operations	2.1 Site/Area Management	Encourage use of wildlife friendly harvest techniques	M
02.1 Annual & Perennial Non-Timber Crops	Lack of plant and insect diversity within fields	2.1 Site/Area Management	Encourage use of Integrated Pest Management in agricultural operations	M
02.1 Annual & Perennial Non-Timber Crops	Lack of plant and structural diversity within landscapes	2.1 Site/Area Management	Encourage more diverse crop rotations	L

Table 8 - Continued.

Other

Alpine

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Leucosticte australis</i>	Brown-capped rosy-finch	<input checked="" type="checkbox"/>	Birds	<i>Leucosticte atrata</i>	Black rosy-finch	<input checked="" type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
Birds	<i>Lagopus leucura altipetens</i>	Southern white-tailed ptarmigan	<input checked="" type="checkbox"/>	Birds	<i>Selasphorus rufus</i>	Rufous hummingbird	<input checked="" type="checkbox"/>
Mammals	<i>Ochotona princeps</i>	American pika	<input checked="" type="checkbox"/>	Insects	<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	<input checked="" type="checkbox"/>
Mammals	<i>Gulo gulo</i>	Wolverine	<input checked="" type="checkbox"/>	Insects	<i>Boloria improba acrocnema</i>	Uncompahgre fritillary	<input checked="" type="checkbox"/>
Plants	<i>Descurainia kenheili</i>	Heil's tansy mustard	<input checked="" type="checkbox"/>	Insects	<i>Bombus occidentalis</i>	Western bumblebee	<input checked="" type="checkbox"/>
Plants	<i>Eutrema penlandii</i>	Penland alpine fen mustard	<input type="checkbox"/>	Mammals	<i>Martes americana</i>	American marten	<input type="checkbox"/>
Plants	<i>Oreoxis humilis</i>	Pikes Peak spring parsley	<input checked="" type="checkbox"/>	Mammals	<i>Ovis canadensis</i>	Bighorn sheep	<input type="checkbox"/>
Plants	<i>Aliciella sedifolia</i>	Stonecrop gilia	<input checked="" type="checkbox"/>	Mammals	<i>Ursus arctos</i>	Grizzly bear	<input checked="" type="checkbox"/>
Plants	<i>Draba weberi</i>	Weber's draba	<input checked="" type="checkbox"/>	Plants	<i>Physaria alpina</i>	Avery Peak twinpod	<input checked="" type="checkbox"/>
Plants	<i>Physaria scrotiformis</i>	West Silver bladderpod	<input checked="" type="checkbox"/>	Plants	<i>Draba exungiculata</i>	Clawless draba	<input checked="" type="checkbox"/>
Plants	<i>Draba malpighiacea</i>	Whitlow-grass	<input checked="" type="checkbox"/>	Plants	<i>Delphinium ramosum var. alpestre</i>	Colorado larkspur	<input checked="" type="checkbox"/>
				Plants	<i>Eriogonum coloradense</i>	Colorado wild buckwheat	<input checked="" type="checkbox"/>
				Plants	<i>Castilleja puberula</i>	Downy Indian paintbrush	<input checked="" type="checkbox"/>
				Plants	<i>Ipomopsis globularis</i>	Globe gilia	<input checked="" type="checkbox"/>
				Plants	<i>Draba grayana</i>	Gray's Peak whitlow-grass	<input checked="" type="checkbox"/>
				Plants	<i>Telesonix jamesii</i>	James telesonix	<input type="checkbox"/>
				Plants	<i>Townsendia rothrockii</i>	Rothrock townsend-daisy	<input checked="" type="checkbox"/>
				Plants	<i>Draba graminea</i>	San Juan whitlow-grass	<input checked="" type="checkbox"/>
				Plants	<i>Saussurea weberi</i>	Weber saussurea	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
09.5 Air-Borne Pollutants	Anthropogenic nitrogen deposition	5.4 Compliance & Enforcement	Enforce state/federal/local pollution standards	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Prepare climate change adaptation strategy to identify and address barriers to species movement and habitat shifting	H
11.3 Temperature Extremes	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	H
06.1 Recreational Activities	Altered vegetation from hiking, camping, etc.	5.4 Compliance & Enforcement	Manage public use to be compatible with biodiversity	M
01.3 Tourism & Recreation Areas	Roads, trails, ski areas	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
02.3 Livestock Farming & Ranching	Altered native vegetation - Sheep grazing	2.1 Site/Area Management	Implement compatible grazing practices	L

Table 8 - Continued.

Other

Barrens

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Plants	<i>Corispermum navicula</i>	Boat-shaped bugseed	<input type="checkbox"/>	Plants	<i>Physaria bellii</i>	Bell's twinpod	<input checked="" type="checkbox"/>
Plants	<i>Eriogonum brandegeei</i>	Brandegee wild buckwheat	<input checked="" type="checkbox"/>	Plants	<i>Lomatium concinnum</i>	Colorado desert-parsley	<input type="checkbox"/>
Plants	<i>Physaria pulvinata</i>	Cushion bladderpod	<input type="checkbox"/>	Plants	<i>Astragalus debequaeus</i>	DeBeque milkvetch	<input type="checkbox"/>
Plants	<i>Phacelia submutica</i>	DeBeque phacelia	<input checked="" type="checkbox"/>	Plants	<i>Townsendia fendleri</i>	Fendler's townsend-daisy	<input checked="" type="checkbox"/>
Plants	<i>Boechea glareosa</i>	Dorn's rockcress	<input checked="" type="checkbox"/>	Plants	<i>Nuttallia chrysantha</i>	Golden blazing star	<input checked="" type="checkbox"/>
Plants	<i>Physaria congesta</i>	Dudley Bluffs bladderpod	<input checked="" type="checkbox"/>	Plants	<i>Penstemon grahamii</i>	Graham beardtongue	<input checked="" type="checkbox"/>
Plants	<i>Penstemon gibbensii</i>	Gibben's beardtongue	<input checked="" type="checkbox"/>	Plants	<i>Townsendia glabella</i>	Gray's townsend-daisy	<input checked="" type="checkbox"/>
Plants	<i>Gutierrezia elegans</i>	Lone Mesa snakeweed	<input type="checkbox"/>	Plants	<i>Oreocarya revealii</i>	Gypsum Valley cat's-eye	<input type="checkbox"/>
Plants	<i>Packera mancosana</i>	Mancos shale packera	<input checked="" type="checkbox"/>	Plants	<i>Oreocarya osterhoutii</i>	Osterhout cat's-eye	<input checked="" type="checkbox"/>
Plants	<i>Sclerocactus mesae-verdae</i>	Mesa Verde hookless cactus	<input checked="" type="checkbox"/>	Plants	<i>Physaria pruinosa</i>	Pagosa bladderpod	<input checked="" type="checkbox"/>
Plants	<i>Phacelia formosula</i>	North Park phacelia	<input checked="" type="checkbox"/>	Plants	<i>Lupinus crassus</i>	Payson lupine	<input type="checkbox"/>
Plants	<i>Ipomopsis polyantha</i>	Pagosa skyrocket	<input type="checkbox"/>	Plants	<i>Physaria parviflora</i>	Piceance bladderpod	<input checked="" type="checkbox"/>
Plants	<i>Penstemon debilis</i>	Parachute penstemon	<input checked="" type="checkbox"/>	Plants	<i>Oonopsis puebloensis</i>	Pueblo goldenweed	<input type="checkbox"/>
Plants	<i>Physaria obcordata</i>	Piceance twinpod	<input checked="" type="checkbox"/>	Plants	<i>Mentzelia rhizomata</i>	Roan Cliffs blazing star	<input checked="" type="checkbox"/>
Plants	<i>Physaria rollinsii</i>	Rollins twinpod	<input type="checkbox"/>	Plants	<i>Oxybaphus rotundifolius</i>	Round-leaf four o'clock	<input checked="" type="checkbox"/>
Plants	<i>Physaria scrotiformis</i>	West Silver bladderpod	<input type="checkbox"/>	Plants	<i>Thalictrum heliophilum</i>	Sun-loving meadow rue	<input checked="" type="checkbox"/>
Plants	<i>Penstemon scariosus</i> var. <i>albifluvis</i>	White River penstemon	<input checked="" type="checkbox"/>				

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Housing, urban and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
03.1 Oil & Gas Drilling	Habitat fragmentation and degradation	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	8.0 Research & Monitoring	Prepare climate change adaptation strategy to identify and address barriers to species movement and habitat shifting	H
06.1 Recreational Activities	Motorized recreation (OHV)	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M

Table 8 - Continued.

Other

Cliffs and Canyons

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Leucosticte australis</i>	Brown-capped rosy-finch	<input type="checkbox"/>	Amphibians	<i>Hyla arenicolor</i>	Canyon tree frog	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input checked="" type="checkbox"/>	Arachnids	<i>Hypochilus bonneti</i>	A lampshade spider	<input checked="" type="checkbox"/>
Mammals	<i>Myotis thysanodes</i>	Fringed myotis	<input checked="" type="checkbox"/>	Birds	<i>Falco peregrinus anatum</i>	American peregrine falcon	<input checked="" type="checkbox"/>
Mammals	<i>Myotis lucifugus</i>	Little brown myotis	<input type="checkbox"/>	Birds	<i>Cypseloides niger</i>	Black swift	<input checked="" type="checkbox"/>
Mammals	<i>Euderma maculatum</i>	Spotted bat	<input checked="" type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Mammals	<i>Corynorhinus townsendii pallescens</i>	Townsend's big-eared bat ssp.	<input checked="" type="checkbox"/>	Birds	<i>Strix occidentalis lucida</i>	Mexican spotted owl	<input checked="" type="checkbox"/>
Plants	<i>Mimulus gemmiparus</i>	Budding monkey flower	<input checked="" type="checkbox"/>	Birds	<i>Falco mexicanus</i>	Prairie falcon	<input checked="" type="checkbox"/>
Plants	<i>Aletes latilobus</i>	Canyonlands aletes	<input checked="" type="checkbox"/>	Insects	<i>Euphilotes rita coloradensis</i>	Colorado blue	<input checked="" type="checkbox"/>
Plants	<i>Astragalus deterior</i>	Cliff-palace milkvetch	<input checked="" type="checkbox"/>	Mammals	<i>Idionycteris phyllotis</i>	Allen's big-eared bat	<input type="checkbox"/>
Plants	<i>Astragalus humillimus</i>	Mancos milkvetch	<input checked="" type="checkbox"/>	Mammals	<i>Nyctinomops macrotis</i>	Big free-tailed bat	<input checked="" type="checkbox"/>
Plants	<i>Hackelia gracilentia</i>	Mesa Verde stickseed	<input type="checkbox"/>	Mammals	<i>Ovis canadensis</i>	Bighorn sheep	<input checked="" type="checkbox"/>
Plants	<i>Erigeron wilkenii</i>	Wilken fleabane	<input checked="" type="checkbox"/>	Plants	<i>Limnorchis zothecina</i>	Alcove bog orchid	<input checked="" type="checkbox"/>
Reptiles	<i>Aspidoscelis neotesselata</i>	Colorado checkered whiptail	<input checked="" type="checkbox"/>	Plants	<i>Anticlea vaginatus</i>	Alcove death camas	<input checked="" type="checkbox"/>
				Plants	<i>Telesonix jamesii</i>	James telesonix	<input checked="" type="checkbox"/>
				Plants	<i>Erigeron kachinensis</i>	Kachina daisy	<input checked="" type="checkbox"/>
				Plants	<i>Aletes humilis</i>	Larimer aletes	<input checked="" type="checkbox"/>
				Plants	<i>Aletes macdougallii ssp. breviradiatus</i>	Mesa Verde aletes	<input checked="" type="checkbox"/>
				Plants	<i>Astragalus naturitensis</i>	Naturita milkvetch	<input checked="" type="checkbox"/>
				Plants	<i>Potentilla rupincola</i>	Rocky Mountain cinquefoil	<input checked="" type="checkbox"/>
				Plants	<i>Draba smithii</i>	Smith whitlow-grass	<input checked="" type="checkbox"/>
				Reptiles	<i>Crotalus oreganus concolor</i>	Midget faded rattlesnake	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Trail development, climbing	5.4 Compliance & Enforcement	Manage public use to be compatible with biodiversity	H
11.2 Droughts	Lack of water for seep habitats	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
03.2 Mining & Quarrying	Rock quarrying	2.1 Site/Area Management	Manage to limit disturbance, especially to roost sites, maternity colonies, and hibernacula	M
03.3 Renewable Energy	Wind turbines in Eastern Colorado outcrop areas	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
04.1 Roads & Railroads	Fragmentation	2.3 Habitat & Natural Process Restoration	Maintain appropriate patch size and habitat mosaic	L

Table 8 - Continued.

Other

Conservation Reserve Program

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Birds	<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	<input checked="" type="checkbox"/>	Birds	<i>Dolichonyx oryzivorus</i>	Bobolink	<input type="checkbox"/>
Birds	<i>Aquila chrysaetos</i>	Golden eagle	<input type="checkbox"/>	Birds	<i>Spizella breweri</i>	Brewer's sparrow	<input type="checkbox"/>
Birds	<i>Centrocercus urophasianus</i>	Greater sage-grouse	<input type="checkbox"/>	Birds	<i>Aimophila cassinii</i>	Cassin's sparrow	<input type="checkbox"/>
Birds	<i>Centrocercus minimus</i>	Gunnison sage-grouse	<input checked="" type="checkbox"/>	Birds	<i>Calcarius ornatus</i>	Chestnut-collared longspur	<input type="checkbox"/>
Birds	<i>Tympanuchus pallidicinctus</i>	Lesser prairie-chicken	<input checked="" type="checkbox"/>	Birds	<i>Buteo regalis</i>	Ferruginous hawk	<input type="checkbox"/>
Birds	<i>Tympanuchus phasianellus jamesi</i>	Plains sharp-tailed grouse	<input checked="" type="checkbox"/>	Birds	<i>Ammodramus savannarum</i>	Grasshopper sparrow	<input checked="" type="checkbox"/>
Reptiles	<i>Aspidoscelis neotessellata</i>	Colorado checkered whiptail	<input type="checkbox"/>	Birds	<i>Tympanuchus cupido</i>	Greater prairie-chicken	<input type="checkbox"/>
Reptiles	<i>Sistrurus catenatus</i>	Massasauga	<input type="checkbox"/>	Birds	<i>Calamospiza melanocorys</i>	Lark bunting	<input type="checkbox"/>
				Birds	<i>Rhynchophanes mccownii</i>	McCown's longspur	<input type="checkbox"/>
				Birds	<i>Colinus virginianus</i>	Northern bobwhite	<input type="checkbox"/>
				Birds	<i>Circus cyaneus</i>	Northern harrier	<input type="checkbox"/>
				Birds	<i>Falco mexicanus</i>	Prairie falcon	<input type="checkbox"/>
				Birds	<i>Amphispiza belli</i>	Sage sparrow	<input type="checkbox"/>
				Birds	<i>Buteo swainsoni</i>	Swainson's hawk	<input type="checkbox"/>
				Mammals	<i>Vulpes velox</i>	Swift fox	<input type="checkbox"/>
				Reptiles	<i>Rhinocheilus lecontei</i>	Long-nosed snake	<input type="checkbox"/>
				Reptiles	<i>Tantilla horbartsmithi</i>	Smith's black-headed snake	<input type="checkbox"/>
				Reptiles	<i>Phrynosoma cornutum</i>	Texas horned lizard	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Decreasing plant diversity and structure; monocultures	2.1 Site/Area Management	Use Mid-Contract Management provisions to increase plant diversity and wildlife benefits	H
02.1 Annual & Perennial Non-Timber Crops	Decreasing plant diversity/monocultures	2.1 Site/Area Management	Plant more diverse seed mixes	H
02.1 Annual & Perennial Non-Timber Crops	Stands converting to undesirable grass species; lack of cover	2.1 Site/Area Management	Avoid haying CRP; plant diverse seed mixes that avoid aggressive grasses	H
02.1 Annual & Perennial Non-Timber Crops	Decrease in CRP acres enrolled	4.3 Awareness & Communications	Provide additional outreach to landowners to increase enrollment	M
02.1 Annual & Perennial Non-Timber Crops	Decrease in CRP acres enrolled	6.4 Conservation Payments	Provide additional enrollment incentives to landowners, offer alternatives for establishing/maintaining similar habitat type	M
02.1 Annual & Perennial Non-Timber Crops	Stands converting to undesirable grass species; lack of cover	2.1 Site/Area Management	Graze only with a prescribed grazing plan that benefits wildlife habitat	M
02.1 Annual & Perennial Non-Timber Crops	Decreasing plant diversity/monocultures	2.1 Site/Area Management	Target placement and design seed mixes in CRP to provide habitat for priority wildlife species	L

Other

Hot Springs

Tier 1 Species

Tier 2 Species

Group	Species	Common Name	Primary
Mollusks	<i>Physa cupreonitens</i>	Hot Springs physa	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.3 Tourism & Recreation Areas	Recreational infrastructure	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	H
03.3 Renewable Energy	Geothermal power development	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	L

Table 8 - Continued.

Other

Sand Dunes

Tier 1 Species				Tier 2 Species			
Group	Species	Common Name	Primary	Group	Species	Common Name	Primary
Plants	<i>Corispermum navicula</i>	Boat-shaped bugseed	<input checked="" type="checkbox"/>	Insects	<i>Amblyderus weneri</i>	Great Sand Dunes anthicid beetle	<input checked="" type="checkbox"/>
				Insects	<i>Cicindela theatina</i>	San Luis Dunes tiger beetle	<input checked="" type="checkbox"/>
				Insects	<i>Euproserpinus wiesti</i>	Wiest's sphinx moth	<input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority			
06.1 Recreational Activities	OHV use	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M			
11.1 Habitat Shifting & Alteration	Potential for increased dune & sheet movement	8.0 Research & Monitoring	Conduct primary research on species and habitat responses to changing climate	M			
02.3 Livestock Farming & Ranching	Conversion to cropland, or other stabilization practices	2.1 Site/Area Management	Implement compatible grazing practices	L			

Chapter 7: Monitoring

Utmost in priority for achieving the goals of the SWAP is the ability to monitor progress toward benchmark measures of success and population security thresholds for species and habitats. This clearly reflects the need for a comprehensive system that allows information from past and future inventories, surveys, research, and management actions to be accumulated, consolidated at multiple scales, and easily and rapidly distributed and compared to benchmarks. Many of the elements needed for such a system are already in place.

CPW and CNHP maintain databases that house detailed biological and location information on wildlife species and habitats in the state. The Crucial Habitat Assessment Tool (CHAT), developed by the Western Governors' Association and multiple conservation partners, prioritizes habitats by importance to vulnerable wildlife species¹⁷. The Colorado Ownership, Management, and Protection database (COMaP) consolidates ownership data on protected lands in the state¹⁸. These data management tools can be used together to support a comprehensive monitoring program to gauge progress toward conservation goals.

Species Monitoring

For species, Colorado's monitoring will first employ existing surveys and inventories, including monitoring being done by CPW and conservation partners (Table 9). For many of our highest priority SGCN, long-term monitoring efforts are on-going. In addition to the monitoring efforts listed in Table 9, CPW resource stewardship staff conduct a variety of monitoring programs on State Park Lands, including raptor monitoring, bird surveys (including song birds, waterfowl, migratory birds), and presence/absence of small mammals and amphibians. In a number of cases, monitoring or research will need to be the first step when existing status of, and threats to, SGCN are unknown. There are three Tier 1 and 41 Tier 2 vertebrate and mollusk SGCN not currently covered by existing monitoring efforts (identified by blanks in Table 9). Development of monitoring programs will be a priority conservation action for many of these species.

CPW's Colorado Natural Areas Program (CNAP) provides monitoring of rare species, especially rare plants, which is further outlined in the Rare Plant SWAP (Appendix A). CNAP and some state parks also periodically inventory invertebrates and use volunteers to monitor butterflies. However, of the non-mollusk invertebrate SGCN, very few species are regularly monitored (Appendix B), and all of those are monitored only at the local scale. Because CPW does not have

¹⁷ <http://westgovchat.org>

¹⁸ http://centroid1.warnercnr.colostate.edu/COMaP_v9/download_comap9.html

legislative authority over these species groups, we rely upon our conservation partners to fill this gap. The Colorado Butterfly Monitoring Network¹⁹, launched in 2013 by the Butterfly Pavilion, and the Xerces Society's BumbleBee Watch²⁰ are two examples of how Coloradans can help meet this need.

Habitat Monitoring

There are currently very few monitoring programs for habitat at a statewide scale. The U.S. Forest Service's national Forest Inventory and Analysis is implemented across all forest types in Colorado by the Colorado State Forest Service²¹. The Colorado State Forest Service also surveys forest insect and disease outbreaks²². Habitat monitoring on State Parks is conducted by CPW resource stewardship staff through vegetation plot monitoring. CNAP conducts long-term monitoring of numerous representative and rare plant communities which are identified and designated within the state's natural areas system. Federal, state, and local public land managers monitor lands within their jurisdictions to varying degrees, but no formal program exists for monitoring habitats across ownership boundaries. As natural resource stewardship evolves over the coming years, identifying new ways to coordinate monitoring of habitats is needed.

Measuring Conservation Success

To facilitate monitoring the effectiveness of implemented conservation efforts at a statewide scale, periodic assessments of the conservation status of SGCN and key habitats will be conducted following methods developed for the State of Colorado's Biodiversity report (Rondeau et al. 2011). The State of Colorado's Biodiversity presents a measure of the effectiveness of conservation action for select species and ecosystems, following a systematic and repeatable scorecard approach. Methods behind the analysis were developed by the Colorado Natural Heritage Program and The Nature Conservancy, with input from CPW. Species and ecosystems were assessed for *biodiversity status*, *threats*, and current *level of protection*. Each of these three main categories was analyzed according to several sub-categories, as appropriate for plants, animals, and ecosystems. Sub-categories for biodiversity status include indicators of both size and condition (e.g., abundance, number of populations, landscape setting, and so on). Threats were evaluated for scope, severity, and immediacy. Protection status was assessed based on the proportion of known populations on lands that are legally protected from conversion (note that this measure reflects the long-term security of the existing land use in a legal framework; it is not suggestive of the relative quality of a given occurrence).

¹⁹ <http://www.nab-net.org/program/colorado-butterfly-monitoring-network>

²⁰ www.BumbleBeeWatch.org

²¹ <http://csfs.colostate.edu/forest-management/forest-inventory-analysis/>

²² <http://csfs.colostate.edu/forest-management/common-forest-insects-diseases/>

All factors, taken together, were combined to provide an overall indication of how effective past and current conservation actions have been in the context of current land use and human activity, as well as what types of conservation strategies might be most effective in the future. Ultimately, species and ecosystems were categorized as Effectively Conserved, Moderately Conserved, Under Conserved, or Poorly Conserved. It is important to understand that these are relative scores from a statewide perspective. These methods do not address regional, watershed, or local status and context. Likewise, they do not address listing factors associated with the Endangered Species Act, and are not appropriate for that purpose. The strength of the scorecard approach is that it supports periodic re-assessment of ecosystems and species status as a way to evaluate progress toward conservation goals. Rondeau et al. (2011) provides additional details on methods and current results (the Executive Summary for the 2011 report is attached as Appendix G; the full report can be downloaded from <http://www.cnhp.colostate.edu>). Note that conditions have already changed for some species and ecosystems reviewed in the 2011 report. Keeping the analysis as well as the underlying data and assumptions current is a high priority for monitoring the status of SGCN and their habitats and the effectiveness of implemented conservation actions.

Our goal is to update the biodiversity status analysis every five to 10 years. This, in conjunction with scheduled review of the SWAP (especially review of species' status relative to Tier 1 and Tier 2 SGCN designation), will provide the information needed to identify conservation successes and emerging needs, prioritize resource expenditures, and direct partner collaboration.

Table 9. Existing monitoring plans for SGCN.

Focus: SS = Single Species; MS = Multi-species. Agency/Organizations: BCNA = Boulder County Nature Association; BLM = Bureau of Land Management; CNHP = Colorado Natural Heritage Program; CPW = Colorado Parks & Wildlife; IWJV = Intermountain West Joint Venture; RMBO = Rocky Mountain Bird Observatory; UDWR = Utah Division of Wildlife Resources; USACOE = U.S. Army Corps of Engineers; USFS = U.S. Forest Service; USFWS = U.S. Fish & Wildlife Service; USGS = U.S. Geological Service; WAFWA = Western Association of Fish & Wildlife Agencies; WYGF = Wyoming Game & Fish.

For each species that has only blank cells in this table, development of a monitoring plan has been added as a conservation action for the species in Table 7.

Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
AMPHIBIANS – TIER 1						
<i>Anaxyrus boreas boreas</i>	Boreal toad (Southern Rocky Mountain population)	(1) Conservation plan and agreement for the management and recovery of the southern Rocky Mountain population of the boreal toad (<i>Bufo boreas boreas</i>). 2001. Boreal Toad Recovery Team, Loeffler, C. (ed.). 76 pp. + appendices. (2) Boreal toad survey and monitoring project summary 1999 - 2012. Lambert and Schneider 2013. Colorado Natural Heritage Program report for Colorado Parks and Wildlife.	SS	X	(1) Multi-state: CO, WY, NM (2) Statewide	(1) CPW and 8 other agency signatories (2) CNHP, CPW
<i>Lithobates pipiens</i>	Northern leopard frog	Dosch, K.L., P.T.J. Johnson, and V. McKenzie. 2008. Northern leopard frog (<i>Lithobates [=Rana] pipiens</i>) sampling protocol for Colorado. University of Colorado, Boulder, CO. 42pp.	SS		Statewide	CPW
BIRDS – TIER 1						
<i>Leucosticte australis</i>	Brown-capped rosy-finch	Indian Peaks four season bird counts, 20 year summary (1982-2001)	MS	X	Local	BCNA
<i>Athene cucularia</i>	Burrowing owl	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/ (3) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife.	MS	X	(1) Multi-state (2) North America (3) Statewide	(1) CPW, USFS, RMBO, BLM (2) USGS (3) CPW

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Tympanuchus phasianellus columbianus</i>	Columbian sharp-tailed grouse	(1) Hoffman, R. W., K. A. Griffin, J. M. Knetter, M. A. Schroeder, A. D. Apa, J. D. Robinson, S. P. Espinosa, T. J. Christiansen, R. D. Northrup, D. A. Budeau, and M. J. Chutter. 2015. Guidelines for the Management of Columbian Sharp-Tailed Grouse Populations and Their Habitats. WAFWA Sage and Columbian Sharp-tailed Grouse Technical Committee, Western Association of Fish and Wildlife Agencies (2) Columbian sharp-tailed grouse conservation plan: Routt, Moffat, and Rio Blanco Counties, Northwest Colorado (3) Annual Lek Surveys - unpublished internal report, no citation	SS	X	Statewide	CPW
<i>Aquila chrysaetos</i>	Golden eagle	(1) Nielson, R. M., Mcmanus, L., Rintz, T., Mcdonald, L. L., Murphy, R. K., Howe, W. H. and Good, R. E. 2014. Monitoring abundance of golden eagles in the western United States. The Journal of Wildlife Management, 78: 721–730. doi: 10.1002/jwmg.704 (2) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife (3) Winter Raptor Survey http://bcna.org/raptorlinks.html	(1) SS (2) MS (3) MS	(2) X (3) X	(1) Western U.S. (2) Statewide (3) Local	(1) USFWS (2) CPW (3) BCNA
<i>Centrocercus urophasianus</i>	Greater sage-grouse	(1) Colorado Greater Sage-Grouse Steering Committee. 2008. Colorado Greater sage-grouse conservation plan. Colorado Parks and Wildlife, Denver, Colorado, USA. (2) Annual Lek Surveys - unpublished internal report, no citation	SS	X	Statewide	CPW
<i>Grus canadensis tabida</i>	Greater sandhill crane	(1) Pacific Flyway wide fall staging counts in production areas (currently limited in Colorado to the upper Yampa River valley, the San Luis Valley, and the Delta vicinity): Subcommittee on Rocky Mountain Greater Sandhill Cranes. 2007. Management plan of the Pacific and Central Flyways for the Rocky Mountain population of greater sandhill cranes. [Joint] Subcommittees, Rocky Mountain Population Greater Sandhill Cranes, Pacific Flyway Study Committee, Central Flyway Webless Migratory Game Bird Tech. Committee [c/o USFWS, MBMO], Portland, OR. 97pp. (2) Yampa Valley breeding population monitoring (a revised monitoring protocol is being pilot tested beginning in 2015): Graham, V. K. 1992. Recovery Plan for the Colorado population of the greater sandhill crane. Colorado Parks and Wildlife, Grand Junction, CO.	SS	X	(1) Multi-state (2) NW Region	(1) USFWS (2) CPW
<i>Centrocercus minimus</i>	Gunnison sage-grouse	(1) Gunnison Sage-Grouse Rangewide Steering Committee. 2005. Gunnison sage-grouse rangewide conservation plan. Colorado Parks and Wildlife, Denver, Colorado, USA. (2) Annual Lek Surveys - unpublished internal report, no citation	SS	X	(1) Range-wide (2) Range in CO	CPW, UDWR

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Tympanuchus pallidicinctus</i>	Lesser prairie-chicken	(1) Range-wide Aerial Surveys: http://www.wafwa.org/documents/LPC-aerial-survey-results-2014.pdf (2) Annual Lek Surveys - unpublished internal report, no citation	SS	X	(1) Range-wide (2) Range in Colorado	(1) WAFWA (2) CPW
<i>Charadrius montanus</i>	Mountain plover	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Tympanuchus phasianellus jamesii</i>	Plains sharp-tailed grouse	Annual Lek Surveys - unpublished internal report, no citation.	SS	X	Weld, Logan, Morgan Counties	CPW
<i>Lagopus leucura altipetens</i>	Southern white-tailed ptarmigan	(1) White-tailed ptarmigan 2012-2013 progress report. Seglund, A.E. and P. Street. CPW 35pp. (2) White-tailed ptarmigan summary report 2011 and project proposal 2012-2014. Seglund A.E. CPW 19pps. Reports outline monitoring using occupancy and mark resight techniques.	SS	X	Statewide	CPW
<i>Empidonax traillii extimus</i>	Southwestern willow flycatcher	Federal survey protocol: http://pubs.usgs.gov/tm/tm2a10/	SS		Rangewide	USFWS, USGS
<i>Coccyzus americanus occidentalis</i>	Western yellow-billed cuckoo	Federal survey protocol.	SS		Rangewide	USFWS
FISH – TIER 1						
<i>Etheostoma cragini</i>	Arkansas darter	(1) Colorado Parks and Wildlife. Krieger, D., T. Nesler, C. Bennett, G. Dowler and J. Melby. 2001. Arkansas Darter (<i>Etheostoma cragini</i>) Recovery Plan. Colorado Parks and Wildlife. 23 pp. (2) DRAFT Conservation Plan for the Native Fishes of the Arkansas River Basin, CO. 2013. Colorado Parks and Wildlife.	(1) SS (2) MS	X	Range in CO	CPW
<i>Catostomus discobolus</i>	Bluehead sucker	Range-Wide Conservation Agreement and Strategy for Roundtail Chub (<i>Gila robusta</i>), bluehead Sucker (<i>Castomus discobolus</i>), and Flannelmouth Sucker (<i>Castomus latipinnis</i>). 2005. Prepared fo the Colorado River Fish and Wildlife Council, by Utah Department of Natural Resources. 61pp.	MS	X	Rangewide	Rotating lead, CPW is current chair

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Gila elegans</i>	Bonytail chub	Upper Colorado River Endangered Fish Recovery Program. 2014. Recovery Implementation Program Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement, October 15, 1993 (revised March 8, 2000), and Recovery Implementation Program Recovery Action Plan (RIPRAP)	MS	X	Upper Colorado River Basin	USFWS
<i>Hybognathus hankinsoni</i>	Brassy minnow	DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	So. Platte Basin in CO	CPW
<i>Ptychocheilus lucius</i>	Colorado pikeminnow	(1) Upper Colorado River Endangered Fish Recovery Program. 2014. Recovery Implementation Program Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement, October 15, 1993 (revised March 8, 2000), and Recovery Implementation Program Recovery Action Plan (RIPRAP) (2) San Juan River Basin Recovery Implementation Program. 2014. Long Range Plan.	MS	X	Rangewide in Upper CO Basin incl. San Juan	USFWS
<i>Oncorhynchus clarkii pleuriticus</i>	Colorado River cutthroat trout	CRCT Coordination Team. 2006. Conservation strategy for Colorado River cutthroat trout (<i>Oncorhynchus clarkii pleuriticus</i>) in the States of Colorado, Utah, and Wyoming. Colorado Parks and Wildlife, Fort Collins. 24p.	SS	X	Rangewide	WYGF
<i>Luxilus cornutus</i>	Common shiner	DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	Range in CO	CPW
<i>Catostomus latipinnis</i>	Flannelmouth sucker	Range-Wide Conservation Agreement and Strategy for Roundtail Chub (<i>Gila robusta</i>), bluehead Sucker (<i>Castomus discobolus</i>), and Flannelmouth Sucker (<i>Castomus latipinnis</i>). 2005. Prepared fo the Colorado River Fish and Wildlife Council, by Utah Department of Natural Resources. 61pp.	MS	X	Rangewide	Rotating lead, CPW is current chair
<i>Platygobio gracilus</i>	Flathead chub	DRAFT Conservation Plan for the Native Fishes of the Arkansas River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	Range in CO	CPW
<i>Oncorhynchus clarkii stomias</i>	Greenback cutthroat trout	(1) U.S. Fish and Wildlife Service. 1998. Greenback cutthroat trout recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado. (2) Recovery Outline (in prep)	SS	X	Rangewide	USFWS, CPW
<i>Gila cypha</i>	Humpback chub	Upper Colorado River Endangered Fish Recovery Program. 2014. Recovery Implementation Program Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement, October 15, 1993 (revised March 8, 2000), and Recovery Implementation Program Recovery Action Plan (RIPRAP)	MS	X	Upper Colorado River Basin	USFWS

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Catostomus playtrhynchus</i>	Mountain sucker	Monitoring as part of routine sampling.			Statewide	CPW
<i>Phoxinus eos</i>	Northern redbelly dace	DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	Range in CO	CPW
<i>Lepomis humilis</i>	Orangespotted sunfish	1) DRAFT Conservation Plan for the Native Fishes of the Arkansas River Basin, CO. 2013. Colorado Parks and Wildlife. 2) DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	(1) Arkansas Basin in CO (2) South Platte Basin in CO	CPW
<i>Etheostoma spectabile</i>	Orangethroat darter	Monitoring as part of routine sampling.			Statewide	CPW
<i>Hybognathus placitus</i>	Plains minnow	(1) DRAFT Conservation Plan for the Native Fishes of the Arkansas River Basin, CO. 2013. Colorado Parks and Wildlife. (2) DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	(1) Arkansas Basin in CO (2) So. Platte Basin in CO	CPW
<i>Fundulus sciadicus</i>	Plains topminnow	DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.				
<i>Xyrauchen texanus</i>	Razorback sucker	(1) Upper Colorado River Endangered Fish Recovery Program. 2014. Recovery Implementation Program Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement, October 15, 1993 (revised March 8, 2000), and Recovery Implementation Program Recovery Action Plan (RIPRAP) (2) San Juan River Basin Recovery Implementation Program. 2014. Long Range Plan.	MS	X	Rangewide in Upper CO Basin incl. San Juan	USFWS
<i>Gila pandora</i>	Rio Grande chub	Monitoring as part of routine sampling.			Statewide	CPW
<i>Oncorhynchus clarkii virginalis</i>	Rio Grande cutthroat trout	RGCT Conservation Team. 2013. Rio Grande cutthroat trout (<i>Oncorhynchus clarkii virginalis</i>) Conservation Strategy. Colorado Parks and Wildlife, Denver, CO.	SS	X	Rangewide	CPW
<i>Catostomus plebeius</i>	Rio Grande sucker	Langlois, D., J. Alves and J. Apker. 1994. Rio Grande sucker recovery plan. Colorado Parks and Wildlife, Denver. 22 pp.	SS	X	Range in CO	CPW

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Gila robusta</i>	Roundtail chub	Range-Wide Conservation Agreement and Strategy for Roundtail Chub (<i>Gila robusta</i>), bluehead Sucker (<i>Castomus discobolus</i>), and Flannelmouth Sucker (<i>Castomus latipinnis</i>). 2005. Prepared for the Colorado River Fish and Wildlife Council, Utah Department of Natural Resources. 61 pp.	MS	X	Rangewide	Rotating lead, CPW is current chair
<i>Phoxinus erythrogaster</i>	Southern redbelly dace	DRAFT Conservation Plan for the Native Fishes of the Arkansas River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	Range in CO	CPW
<i>Noturus flavus</i>	Stonecat	DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	So. Platte Basin in CO	CPW
<i>Phenacobius mirabilis</i>	Suckermouth minnow	(1) DRAFT Conservation Plan for the Native Fishes of the Arkansas River Basin, CO. 2013. Colorado Parks and Wildlife. (2) DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.	MS	X	(1) Arkansas Basin in CO (2) So. Platte Basin in CO	CPW
MAMMALS – TIER 1						
<i>Ochotona princeps</i>	American pika	American Pika surveys 2008-2012 Colorado Parks and Wildlife. Seglund, A. 33pp. Outlines monitoring protocol using occupancy.	SS	X	Statewide	CPW
<i>Mustela nigripes</i>	Black-footed ferret	Black-footed Ferret Recovery Plan, 2nd revision. 2013. U.S. Fish and Wildlife Service, Denver, CO.	SS	X	Rangewide	USFWS, CPW
<i>Myotis thysanodes</i>	Fringed myotis	(1) NABat (USGS draft) (2) CPW WNS Surveillance Plan, http://cpw.state.co.us/Documents/Research/WildlifeHealth/CPW_BatWNSsurveillanceplan_20112012.pdf (3) Surveillance, monitoring and life history investigations of bats within Colorado, multiple reports	MS	(1) X	(1) Rangewide (2) Site, Statewide (3) Regional	(1) USGS, CPW (2) CPW (3) CPW, BLM, CNHP
<i>Cynomys gunnisoni</i>	Gunnison's prairie dog	Protocol for conducting prairie dog occupancy surveys. 2007. Andelt, W.F. and A.E. Seglund. Colorado Parks and Wildlife. 14pp.	SS	X	Rangewide	CPW
<i>Myotis lucifugus</i>	Little brown bat	(1) NABat (USGS draft) (2) CPW WNS Surveillance Plan, http://cpw.state.co.us/Documents/Research/WildlifeHealth/CPW_BatWNSsurveillanceplan_20112012.pdf (3) Surveillance, monitoring and life history investigations of bats within Colorado, multiple reports	MS	(1) X	(1) Rangewide (2) Site, Statewide (3) Regional	(1) USGS, CPW (2) CPW (3) CPW, BLM, CNHP
<i>Lynx canadensis</i>	Lynx	Protocol for Monitoring Canada Lynx in Colorado. 2014. Ivan, J., and T. Shenk. Colorado Parks and Wildlife. 37 pp.	SS	X	Statewide	CPW, USFS, BLM

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Zapus hudsonius luteus</i>	New Mexico meadow jumping mouse	(1) Species Status Assessment Report for the New Mexico meadow jumping mouse (<i>Zapus hudsonius luteus</i>). 2014. U.S. Fish and Wildlife Service, Albuquerque, NM. (2) USFWS Recovery Outline: New Mexico Meadow Jumping Mouse - status pending http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0BX	SS		Rangewide	USFWS
<i>Perognathus fasciatus</i>	Olive-backed pocket mouse					
<i>Zapus hudsonius preblei</i>	Prebles meadow jumping mouse	None currently (development of monitoring plan is an action under the current draft of the Recovery Plan)				
<i>Lontra canadensis</i>	River otter	State of Colorado River Otter Recovery Plan. 2003. Colorado Parks and Wildlife. 51pp. http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/CDOW2003Riverotterrecoveryplan.pdf#search=river%20otter	SS	X	Basin	CPW
<i>Euderma maculatum</i>	Spotted bat	(1) NABat (USGS draft) (2) CPW WNS Surveillance Plan, http://cpw.state.co.us/Documents/Research/WildlifeHealth/CPW_BatWNSsurveillanceplan_20112012.pdf (3) Surveillance, monitoring and life history investigations of bats within Colorado, multiple reports	MS	(1) X	(1) Rangewide (2) Site, Statewide (3) Regional	(1) USGS, CPW (2) CPW (3) CPW, BLM, CNHP
<i>Corynorhinus townsendii pallascens</i>	Townsend's big-eared bat ssp.	(1) NABat (USGS draft) (2) CPW WNS Surveillance Plan, http://cpw.state.co.us/Documents/Research/WildlifeHealth/CPW_BatWNSsurveillanceplan_20112012.pdf (3) Surveillance, monitoring and life history investigations of bats within Colorado, multiple reports	MS	(1) X	(1) Rangewide (2) Site, Statewide (3) Regional	(1) USGS, CPW (2) CPW (3) CPW, BLM, CNHP
<i>Cynomys leucurus</i>	White-tailed prairie dog	Protocol for conducting prairie dog occupancy surveys. 2007. Andelt, W.F. and A.E. Seglund. Colorado Parks and Wildlife. 14pp.	SS	X	Rangewide	CPW
<i>Gulo gulo</i>	Wolverine					

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
REPTILES – TIER 1						
<i>Aspidoscelis neotesselata</i>	Colorado checkered whiptail	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
<i>Sistrurus catenatus</i>	Massasauga	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
AMPHIBIANS – TIER 2						
<i>Hyla arenicolor</i>	Canyon tree frog					
<i>Scaphiopus couchii</i>	Couch's spadefoot					
<i>Spea intermontana</i>	Great Basin spadefoot					
<i>Gastrophryne olivacea</i>	Great Plains narrowmouth toad					
<i>Anaxyrus debilis</i>	Green toad					
<i>Acris crepitans</i>	Northern cricket frog					
<i>Lithobates blairi</i>	Plains leopard frog					
<i>Lithobates sylvatica</i>	Wood frog					
BIRDS – TIER 2						
<i>Botaurus lentiginosus</i>	American bittern					
<i>Falco peregrinus anatum</i>	American peregrine falcon	(1) Post-delisting Monitoring Plan: http://www.fws.gov/endangered/esa-library/pdf/Peregrineplan2003.pdf (2) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife	(1) SS (2) MS	X	(1) U.S. (2) Statewide	(1) USFWS (2) CPW
<i>Pelecanus erythrorhynchos</i>	American white pelican	(1) http://www.fws.gov/mountain-prairie/species/birds/western_colonial/Atlas_WCWS_interior_1-23-2014_FINAL.pdf (2) Project Colony Watch http://rmb.org/v3/avian/CitizenScience/ColonyWatch.aspx	MS		(1) Interior Western U.S. (2) Colorado	(1) USFWS (2) RMBO

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Haliaeetus leucocephalus</i>	Bald eagle	(1) Post-delisting Monitoring Plan: http://www.fws.gov/midwest/eagle/protect/pdf/BEPDMP_100511_OMB_FINALfor%20posting_Jan2013Final.pdf (2) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife. (3) Winter Raptor Survey http://bcna.org/raptorlinks.html	(1) SS (2) MS (3) MS	X	(1) U.S. (2) Statewide (3) Local	(1) USFWS (2) CPW (3) BCNA
<i>Patagioenas fasciata</i>	Band-tailed pigeon					
<i>Bucephala islandica</i>	Barrow's goldeneye					
<i>Leucosticte atrata</i>	Black rosy-finch					
<i>Cypseloides niger</i>	Black swift					
<i>Chlidonias niger</i>	Black tern	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS		(1) Interior Western U.S. (2) Colorado	(1) USFWS (2) RMBO
<i>Dolichonyx oryzivorus</i>	Bobolink	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Aegolius funereus</i>	Boreal owl	Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife.	MS	X	Statewide	CPW
<i>Spizella breweri</i>	Brewer's sparrow	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/ (3) 50-years of bird banding data from the Allegra Collister Nature Preserve, Boulder County, 2011	MS	X	(1) Multi-state (2) North America (3) Local	(1) CPW, USFS, RMBO, BLM (2) USGS (3) BCNA
<i>Peucaea cassinii</i>	Cassin's finch	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Aimophila cassinii</i>	Cassin's sparrow	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Calcarius ornatus</i>	Chestnut-collared longspur	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Buteo regalis</i>	Ferruginous hawk	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/ (3) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife. (4) Winter Raptor Survey: http://bcna.org/raptorlinks.html	MS	X	(1) Multi-state (2) North America (3) Statewide (4) Local	(1) CPW, USFS, RMBO, BLM (2) USGS (3) CPW (4) BCNA
<i>Otus flammeolus</i>	Flammulated owl	Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife.	MS	X	Statewide	CPW
<i>Setophaga graciae</i>	Grace's warbler	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Ammodramus savannarum</i>	Grasshopper sparrow	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Vireo vicinior</i>	Gray vireo	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Tympanuchus cupido</i>	Greater prairie-chicken	(1) Greater prairie-chicken inventory assessment. 2005. Stratman, M. Colorado Parks and Wildlife. 15pp. (2) Annual Lek Surveys - unpublished internal report, no citation	SS	X	Rangewide	CPW
<i>Baeolophus ridgwayi</i>	Juniper titmouse	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Calamospiza melanocorys</i>	Lark bunting	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Passerina amoena</i>	Lazuli bunting	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Sterna antillarum</i>	Least tern	(1) Endangered Species Management Plan for Piping Plovers and Interior Least Terns (John Martin Reservoir Project and John Martin State Park). US Army Corps of Engineers. May 22, 2002 (2) Piping Plover and Interior Least Tern Recovery Plan. State of Colorado, Jennifer Slater. September 1994. http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/PipingPloverLeastTernRecoveryPlan.pdf (3) Piping Plover and Least Tern Monitoring, Protection, and Habitat Improvement At John Martin Reservoir and Southeast Colorado. Duane Nelson. October 14, 2014, September 30, 2013.	MS	X	CO	(1) CPW (2) US Army Corps of Engineers
<i>Melanerpes lewis</i>	Lewis's woodpecker	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Lanius ludovicianus</i>	Loggerhead shrike	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Numenius americanus</i>	Long-billed curlew	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Rhynchophanes mccownii</i>	McCown's longspur	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Strix occidentalis lucida</i>	Mexican spotted owl	(1) Federal survey protocol: http://www.fws.gov/mountain-prairie/endspp/protocols/MexicanSpottedOwlSurveyProtocol2012.pdf (2) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife.	(1) SS (2) MS	(2) X	(1) Rangewide (2) Statewide	(1) USFWS (2) CPW
<i>Colinus virginianus</i>	Northern bobwhite	Management procedures for northern bobwhites in eastern Colorado. 1984. Snyder, W. Special Report #56. Colorado Parks and Wildlife. 22pp.	SS	X	Statewide	CPW
<i>Accipiter gentilis</i>	Northern goshawk	Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife.	MS	X	Statewide	CPW
<i>Circus cyaneus</i>	Northern harrier	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/ (3) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife. (4) Winter Raptor Survey http://bcna.org/raptorlinks.html	MS	X	(1) Multi-state (2) North America (3) Statewide (4) Local	(1) CPW, USFS, RMBO, BLM (2) USGS (3) CPW (4) BCNA
<i>Contopus cooperi</i>	Olive-sided flycatcher	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Gymnorhinus cyanocephalus</i>	Pinyon jay	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Charadrius melodus</i>	Piping plover	(1) Endangered Species Management Plan for Piping Plovers and Interior Least Terns (John Martin Reservoir Project and John Martin State Park). US Army Corps of Engineers. May 22, 2002 (2) Piping Plover and Interior Least Tern Recovery Plan. State of Colorado, Jennifer Slater. September 1994. http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/PipingPloverLeastTernRecoveryPlan.pdf (3) Piping Plover and Least Tern Monitoring, Protection, and Habitat Improvement At John Martin Reservoir and Southeast Colorado. Duane Nelson. October 14, 2014, September 30, 2013.	MS	X	CO	(1) CPW (2) USACOE
<i>Falco mexicanus</i>	Prairie falcon	(1) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife. (2) Winter Raptor Survey http://bcna.org/raptorlinks.html	MS	X	(1) Statewide (2) Local	(1) CPW (2) BCNA

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Progne subis</i>	Purple martin	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Selasphorus rufus</i>	Rufous hummingbird	Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	North America	USGS
<i>Amphispiza belli</i>	Sage sparrow	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Asio flammeus</i>	Short-eared owl	Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife.	MS	X	Statewide	CPW
<i>Buteo swainsoni</i>	Swainson's hawk	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/ (3) Raptor Monitoring Strategy, 2015 Draft, Colorado Parks and Wildlife.	MS	X	(1) Multi-state (2) North America (3) Statewide	(1) CPW, USFS, RMBO, BLM (2) USGS (3) CPW
<i>Bartramia longicauda</i>	Upland sandpiper	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Catharus fuscescens</i>	Veery	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Oreothlypis virginiae</i>	Virginia's warbler	(1) Integrated Monitoring in BCRs: http://rmbo.org/v3/avian/Projects/IntegratedMonitoringinBirdConservationRegions.aspx (2) Breeding Bird Survey: https://www.pwrc.usgs.gov/bbs/	MS	X	(1) Multi-state (2) North America	(1) CPW, USFS, RMBO, BLM (2) USGS
<i>Charadrius alexandrinus nivosus</i>	Western snowy plover	(1) Snowy Plover Survey Summary, Blanca Wetlands, San Luis Valley, 2014 BLM unpublished report (2) International Snowy Plover Survey Protocol, Discrete Site Survey Methodologies, 2007 USFWS	SS	X	(1) Regional (2) Statewide	(1) BLM (2) USFWS, IWJV

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Plegadis chihi</i>	White-faced ibis	(1) http://www.fws.gov/mountain-prairie/species/birds/western_colonial/Atlas_WCWS_interior_1-23-2014_FINAL.pdf (2) Project Colony Watch http://rmbo.org/v3/avian/CitizenScience/ColonyWatch.aspx	MS		(1) Interior Western U.S. (2) Colorado	(1) USFWS (2) RMBO
<i>Grus americana</i>	Whooping crane	Annual Survey: http://www.fws.gov/refuge/aransas/science/whooping_crane_surveys.html	SS	X	Wintering Grounds	USFWS
FISH – TIER 2						
<i>Etheostoma exile</i>	Iowa darter	DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.				
<i>Couesius plumbeus</i>	Lake chub	DRAFT Conservation Plan for the Native Fishes of the South Platte River Basin, CO. 2013. Colorado Parks and Wildlife.				
MAMMALS – TIER 2						
<i>Sciurus aberti</i>	Abert's squirrel					
<i>Idionycteris phyllotis</i>	Allen's big-eared bat	(1) NABat (USGS draft) (2) CPW WNS Surveillance Plan, http://cpw.state.co.us/Documents/Research/WildlifeHealth/CPW_BatWNSurveillanceplan_20112012.pdf (3) Surveillance, monitoring and life history investigations of bats within Colorado, multiple reports	MS	(1) X	(1) Rangewide (2) Site, Statewide (3) Regional	(1) USGS, CPW (2) CPW (3) CPW, BLM, CNHP
<i>Martes americana</i>	American marten					
<i>Nyctinomops macrotis</i>	Big free-tailed bat	(1) NABat (USGS draft) (2) CPW WNS Surveillance Plan, http://cpw.state.co.us/Documents/Research/WildlifeHealth/CPW_BatWNSurveillanceplan_20112012.pdf (3) Surveillance, monitoring and life history investigations of bats within Colorado, multiple reports	MS	(1) X	(1) Rangewide (2) Site, Statewide (3) Regional	(1) USGS, CPW (2) CPW (3) CPW, BLM, CNHP

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Ovis canadensis</i>	Bighorn sheep	(1) Stiver, J. R. 2011. Bighorn sheep management plan: Data analysis unit RBS-8, Pikes Peak/DomeRock/Beaver Creek Sheep Herd. Colorado Parks and Wildlife. Colorado Springs, CO 42 pp. http://cpw.state.co.us/Documents/Hunting/BigGame/DAU/BighornSheep/RBS-8DAUplan.pdf (2) Stiver, J. R. 2014. Bighorn sheep management plan: Data analysis unit RBS-14, Rampart Herd. Colorado Parks and Wildlife. Colorado Springs, CO. 27 pp. http://cpw.state.co.us/Documents/Hunting/BigGame/DAU/BighornSheep/RBS-14DAUPlanFinal.pdf (3) Diamond, B. and B. Banulis. 2012. Bighorn Sheep Management Plan: Data Analysis Unit RBS-21, San Juans West, Game Management Units S-21 & S-33. Colorado Parks and Wildlife. Montrose, CO. 106 pp. http://cpw.state.co.us/Documents/Hunting/BigGame/DAU/BighornSheep/RBS21DAUplan_SanJuansWest.pdf (4) George, J. L., R. Kahn, M. W. Miller, and B. Watkins. 2009. Colorado Bighorn Sheep Management Plan 2009-2019. Colorado Parks and Wildlife. Denver, CO. 88 pp.	SS	X	Local, Statewide	CPW
<i>Bison bison</i>	Bison					
<i>Cynomys ludovicianus</i>	Black-tailed prairie dog	USGS Protocol, McDonald, L.L., Stanley, T.R., Otis, D.L., Biggins, D.E., Stevens, P.D., Koprowski, J.L., and Ballard, Warren. 2011. Recommended methods for range-wide monitoring of prairie dogs in the United States: U.S. Geological Survey Scientific Investigations Report 2011-5063, 36p.	SS	X	Rangewide	CPW
<i>Thomomys bottae rubidus</i>	Botta's pocket gopher (<i>rubidus</i> ssp)					
<i>Conepatus leuconotus</i>	Common hog-nosed skunk					
<i>Sorex nanus</i>	Dwarf shrew					
<i>Canis lupus</i>	Gray wolf - two subspecies (Northern and Mexican)	Respond to sighting reports - no formal monitoring program				CPW
<i>Ursus arctos</i>	Grizzly bear	Respond to sighting reports - no formal monitoring program				CPW

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Lasiurus cinereus</i>	Hoary bat	(1) NABat (USGS draft) (2) CPW WNS Surveillance Plan, http://cpw.state.co.us/Documents/Research/WildlifeHealth/CPW_BatWNSsurveillanceplan_20112012.pdf (3) Surveillance, monitoring and life history investigations of bats within Colorado, multiple reports	MS	(1) X	(1) Rangewide (2) Site, Statewide (3) Regional	(1) USGS, CPW (2) CPW (3) CPW, BLM, CNHP
<i>Vulpes macrotis</i>	Kit fox	(1) Kit Fox 2007 survey report southwestern region. Seglund A.E. and J. Garner. CPW 17pp. (2) 2008 year-end survey report non-invasive sampling survey results for kit fox in west-central colorado. Reed- Eckert, M. CPW 22pp.	SS	X	Local	CPW
<i>Sorex preblei</i>	Preble's shrew					
<i>Brachylagus idahoensis</i>	Pygmy rabbit					
<i>Sorex hoyi montanus</i>	Pygmy shrew					
<i>Clethrionomys gapperi</i>	Red-backed vole					
<i>Lemmiscus curtatus</i>	Sagebrush vole					
<i>Lepus americanus</i>	Snowshoe hare	SW Region Long term pellet counts (Wait)	SS	X	Basin	CPW
<i>Vulpes velox</i>	Swift fox	Conservation assessment and conservation strategy for swift fox in the United States-2011 update. Dowd Stukel, E., ed. 2011. South Dakota Department of Game, Fish, and Parks, Pierre. 100pp. http://cpw.state.co.us/learn/Pages/SwiftFoxConservationTeam.aspx	SS	X	Rangewide	CPW
<i>Lepus townsendii</i>	White-tailed jackrabbit					
REPTILES – TIER 2						
<i>Thamnophis cyrtopsis</i>	Black-necked gartersnake					
<i>Lampropeltis californiae</i>	California kingsnake	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Thamnophis sirtalis</i>	Common gartersnake					
<i>Hypsiglena chlorophaea</i>	Desert nightsnake	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
<i>Sceloporus magister</i>	Desert spiny lizard					
<i>Gambelia wislizenii</i>	Long-nosed leopard lizard					
<i>Rhinocheilus lecontei</i>	Long-nosed snake	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
<i>Crotalus oreganus concolor</i>	Midget faded rattlesnake					
<i>Lampropeltis triangulum</i>	Milksnake	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
<i>Rena dissectus</i>	New Mexico threadsnake	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
<i>Phrynosoma modestum</i>	Round-tailed horned lizard	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
<i>Tantilla horbartsmithi</i>	Smith's black-headed snake					
<i>Phrynosoma cornutum</i>	Texas horned lizard	Draft Great Plains Reptile Monitoring Protocol (D. Martin)	MS	X	Regional	CSU, CPW
<i>Kinosternon flavescens</i>	Yellow mud turtle					
MOLLUSKS – TIER 2						
<i>Ferrissia walkeri</i>	Cloche ancyloid					
<i>Promenetus umbilicatellus</i>	Cockerell					
<i>Anodontooides ferussacianus</i>	Cylindrical papershell					

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Ferrissia fragilis</i>	Fragil ancyloid					
<i>Physa cupreonitens</i>	Hot springs physa					
<i>Uniomerus tetralasmus</i>	Pondhorn					
<i>Acroloxus coloradensis</i>	Rocky Mountain capshell					
<i>Promenetus exacuus</i>	Sharp sprite					
<i>Physa gyrina utahensis</i>	Utah physa					

Chapter 8: Conservation Opportunity Areas

This chapter presents a series of maps to help guide conservation efforts across the state. These maps are useful for broad-scale analysis of where conservation efforts might be most warranted and most successful. *It is important to note that these maps take into consideration only those environmental factors that can be mapped at a statewide scale using available data.*

The first six maps indicate relative condition of freshwater, terrestrial upland, and wetland/riparian habitats. This information can be used to identify areas at a broad scale that are likely to be in higher quality condition, and therefore good candidates for land protection strategies, as well as those that are more likely in degraded condition and in need of restoration. The final two maps display SGCN concentration areas for aquatic and terrestrial species, respectively.

Freshwater Habitats

The freshwater condition map for Colorado, developed by The Nature Conservancy and included here with permission, provides a general indication of the condition of freshwater ecosystems in Colorado (Figure 13). Details on data inputs and methods can be found in TNC (2012). The map displays relative level of impact for each stream reach based on multiple mappable landscape measures, each of which were ranked on a scale of Very Good to Poor (Table 10). A stream reach with a good or very good rank (minimal or low impact) may benefit from prioritized protection efforts. It is important to note that even a stream reach with a poor ranking may provide important habitat and support species of concern. However, the poor ranking indicates that those species may be at risk, and serves as a guideline for identifying places that could benefit from restoration efforts. Map categories range from minimal impact (very good condition) to high impact (very poor condition), according to the definitions in Table 11.

Table 10. Measures included in the freshwater condition map. All factors are weighted equally.

Natural Flow Regime	Riparian Condition	Development	Connectivity	Water Quality
<ul style="list-style-type: none"> • Consumptive Use (Agricultural Use, Municipal Use, Trans-basin Diversions) • Reservoir Storage 	<ul style="list-style-type: none"> • Riparian Land Use • Non-native Plants – Tamarisk – in the Riparian Vegetation 	<ul style="list-style-type: none"> • Land Use • Road Density • Road Crossings • Oil and Gas • Mining 	<ul style="list-style-type: none"> • Instream Barriers to Fish Movement 	<ul style="list-style-type: none"> • Streams with a 303d and/or Monitoring and Evaluation Designation

Table 11. Definitions of map categories for freshwater condition.

Level of Impact	Summary Measure
Minimal	All measures in Very Good or Good category
Low	>=1 category is Fair; all others Very Good or Good
Moderate	1-2 categories are Poor; all others Very Good, Good, or Fair
High	>2 categories are Poor

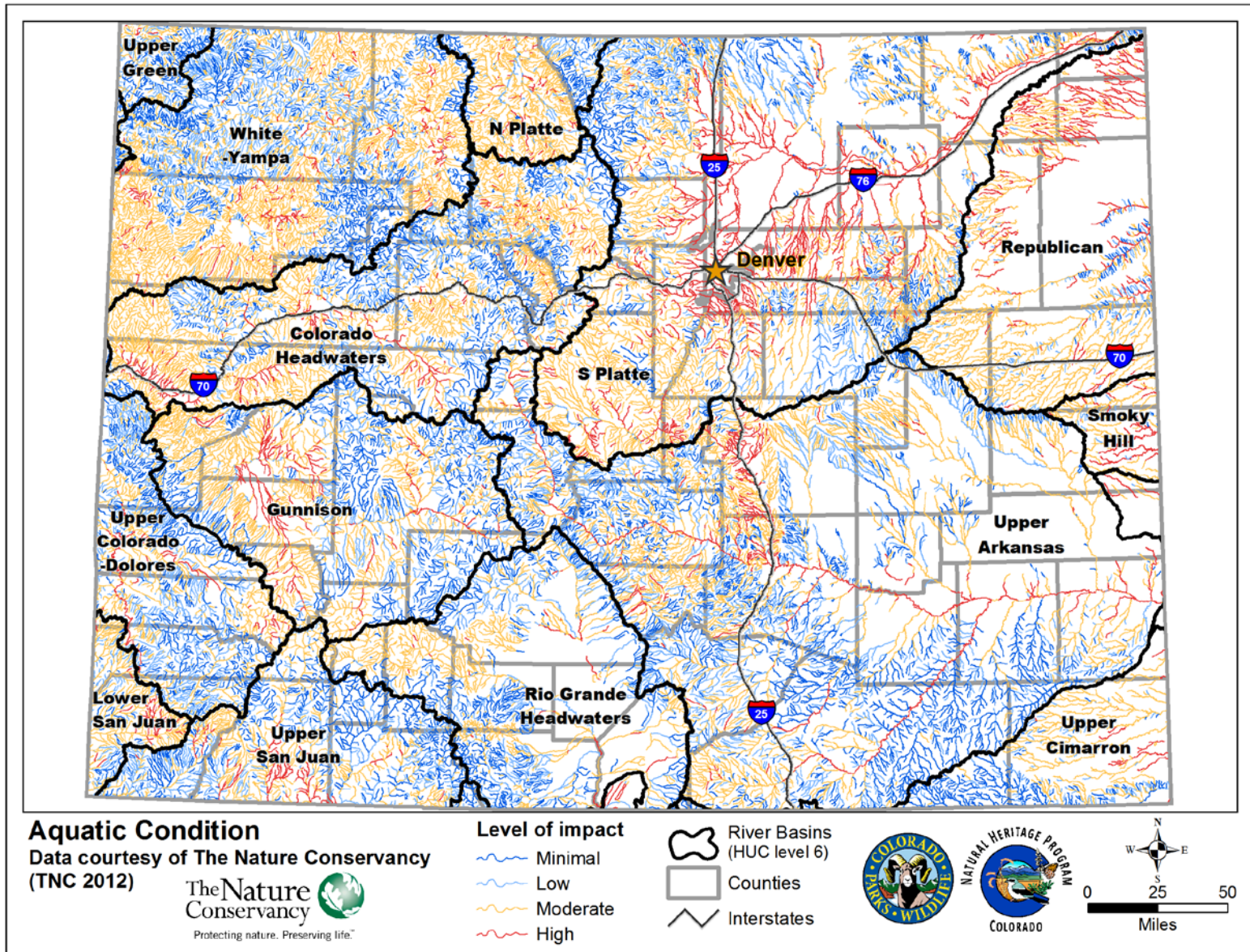


Figure 13. Condition of freshwater habitats in Colorado.

Terrestrial Landscape Integrity Model

This map is the terrestrial upland counter-part to the aquatic condition map. This model was originally created for Rondeau et al. 2011²³, but has been updated for inclusion in the SWAP. This model is based on mapped locations of seven land-use impacts: urban development, crop agriculture, roads, oil and gas wells, above-ground transmission lines and pipelines, surface mines, and wind turbines. Data used to map these land uses are listed in Table 12. Distance decay curves representing the area that effects extend beyond the footprint of the land use were incorporated (Figure 14). This was done in recognition that impacts from any particular land-use disturbance extend some distance out from the source of the impact, but lessen over that distance. The resulting model (Figure 15) provides a statewide perspective for location and relative degree of human impact on the landscape. The assumption is that where impacts are higher, general condition of remaining habitat is likely to be decreased, and vice versa. See Rondeau et al. (2011) for detailed analysis methods.

Table 12. Source data for land uses represented in the landscape integrity model.

Land Use	Source Data
High/med intensity development	SWReGAP high/medium development types
Low intensity development	SWReGAP low intensity development types
Agriculture*	SWReGAP agriculture
Roads - primary & secondary	2013 TIGER/Line roads
Roads - local & rural	2013 TIGER/Line roads
Oil & gas wells - active	Colorado Oil & Gas Commission (2015)
Oil & gas wells - inactive	Colorado Oil & Gas Commission (2015)
Gas pipelines	2013 TIGER/Line utilities
Transmission lines	Powerline Corridors in the Western United States and Canada (Connelly et al. 2004)
Surface Mines - active	Colo. Division of Reclamation, Mining, & Safety (2013)
Surface Mines - inactive	Colo. Division of Reclamation, Mining, & Safety (2013)
Wind Turbines	USGS Onshore Industrial Wind Turbine Locations for the United States (2014)

*The agriculture category in SWReGAP includes cropland and irrigated hay fields.

²³ http://www.cnhp.colostate.edu/download/documents/2011/Scorecard_march1_2012_final.pdf

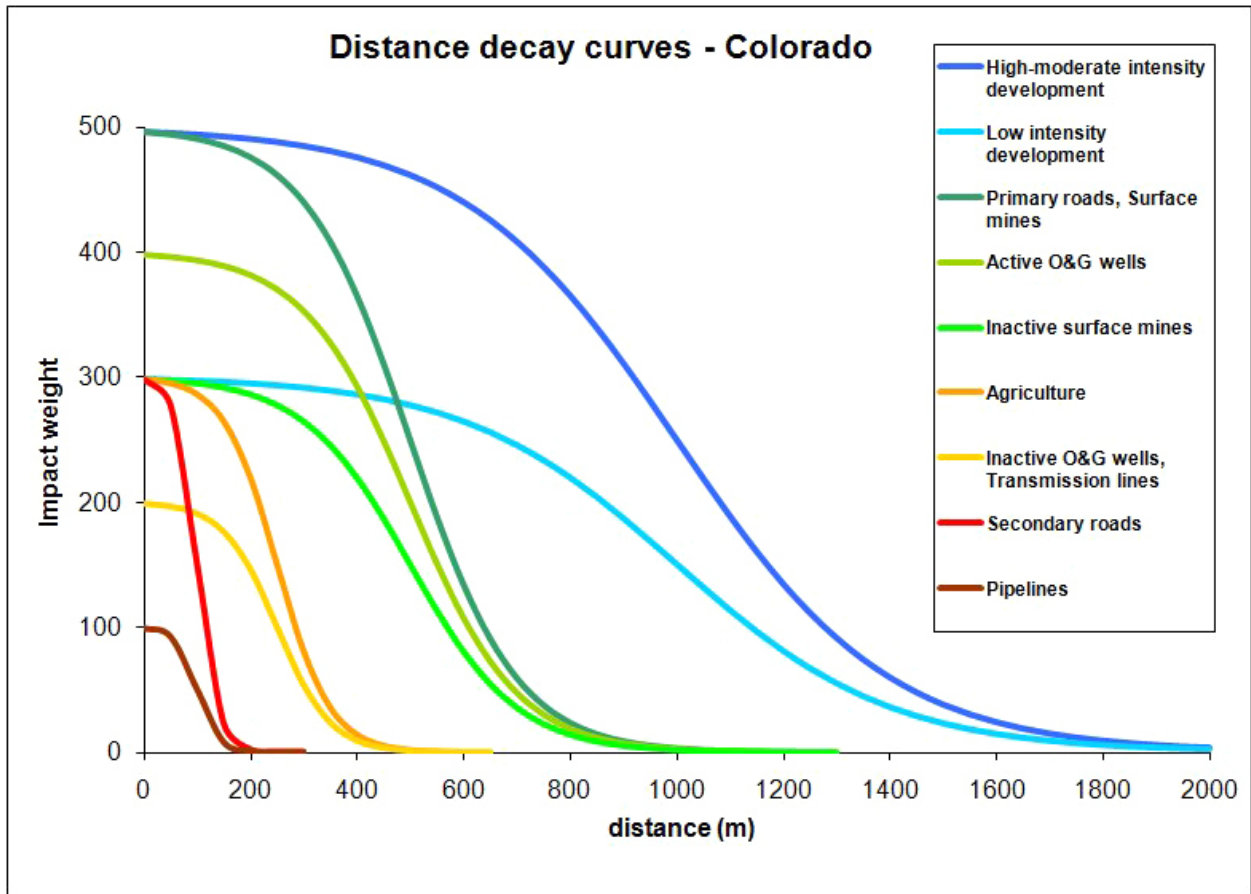


Figure 14. Distance decay curves for land uses represented in the landscape integrity model.

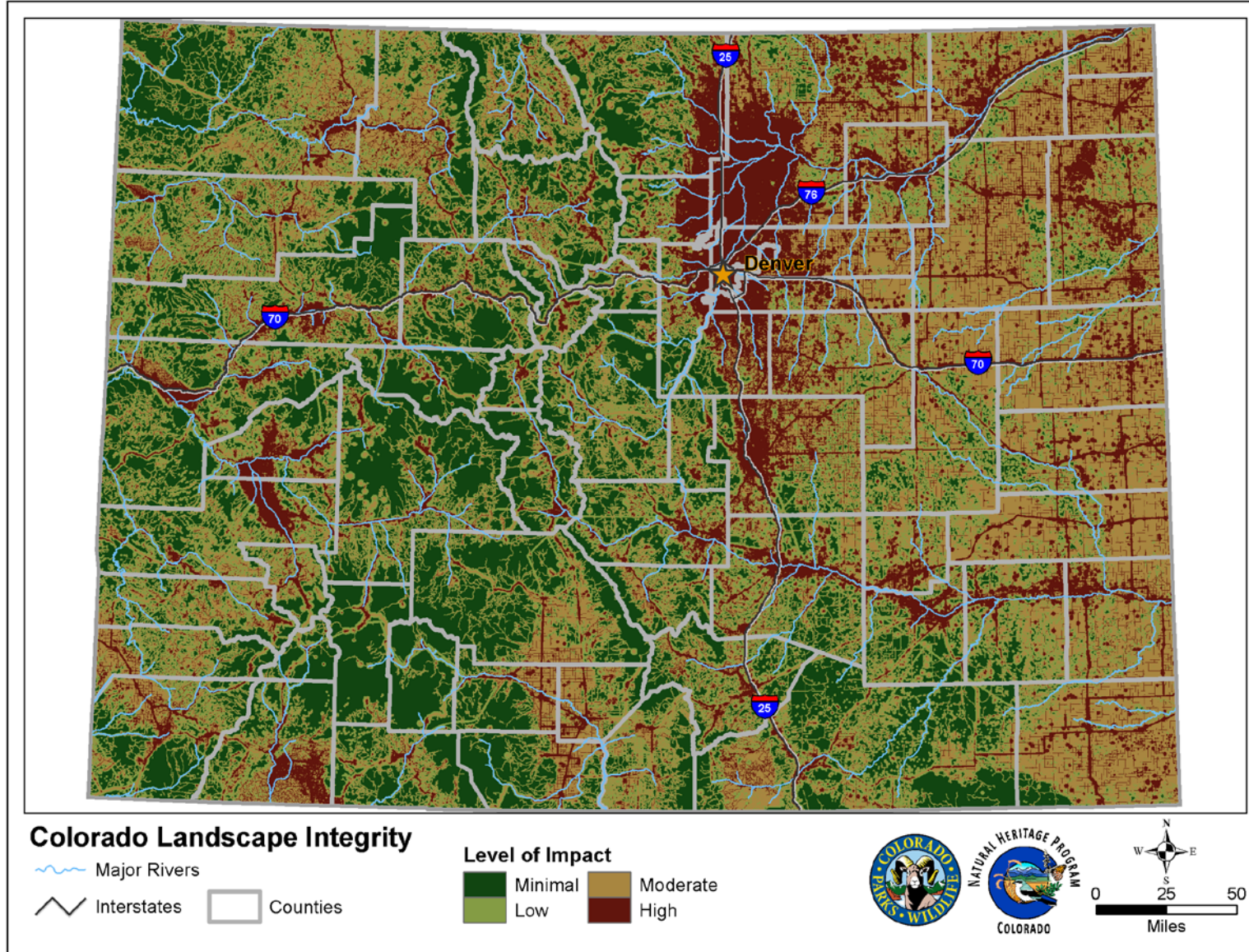


Figure 15. Landscape integrity model for Colorado.

Wetland and Riparian Habitats

Through a partnership among the USFWS, CPW, and CNHP, fine-scale mapping of wetlands based on the U.S. Fish and Wildlife Service's National Wetland Inventory Program has been completed for Colorado (USFWS 2010, as edited by CNHP in 2014). In addition, the Rocky Mountain Bird Observatory and Playa Lakes Joint Venture have developed a GIS data layer for playas on Colorado's eastern plains (RMBO 2009). These data were used in conjunction with a wetland-specific landscape integrity model to produce Figure 16, which depicts level of human impact on wetland and riparian habitats. For each wetland/riparian polygon, the mean value of the overlapping portion of the wetland landscape integrity layer was calculated to estimate general level of impact for that habitat patch. Work is currently underway to explore field and mapping methods for determining wetland quality (Lemly et al. 2011). This goal is complicated by the fact that quality measures from a floristic standpoint and from a wildlife standpoint are not necessarily equivalent. Results of this exploration were not complete in time for inclusion in this iteration of Colorado's SWAP. Our hope is that the next SWAP revision will include a more robust treatment of condition for these high priority habitats.

The wetland-specific landscape integrity model for Colorado is meant to reflect the impact to wetland and riparian habitats from cumulative, mappable, anthropogenic changes to the land and water. This model is based on the inputs listed in Table 13.

Table 13. Data sources for the wetland-specific landscape integrity model.

Land Use	Source Data
Housing & commercial development	LANDFIRE Current Vegetation for Colorado (2006)
Low intensity development	SWReGAP low intensity development types
Agriculture - tilled, fallow tilled, orchards & vineyards	LANDFIRE Current Vegetation for Colorado (2013)
Oil & gas wells	Colorado Oil & Gas Commission (2015)
Wind turbines	CNHP (2011)
Active sand & gravel mines	Colo. Division of Reclamation, Mining, & Safety (2008)
Other active mines	Colo. Division of Reclamation, Mining, & Safety (2008)
Reservoir storage as a proportion of mean annual flows	The Nature Conservancy (2012)
Altered flow as a proportion of mean annual flows	The Nature Conservancy (2012)
Density of dams & diversions	The Nature Conservancy (2012)
Water wells - active	The Nature Conservancy (2012)
Tamarisk infestations	The Nature Conservancy (2012)

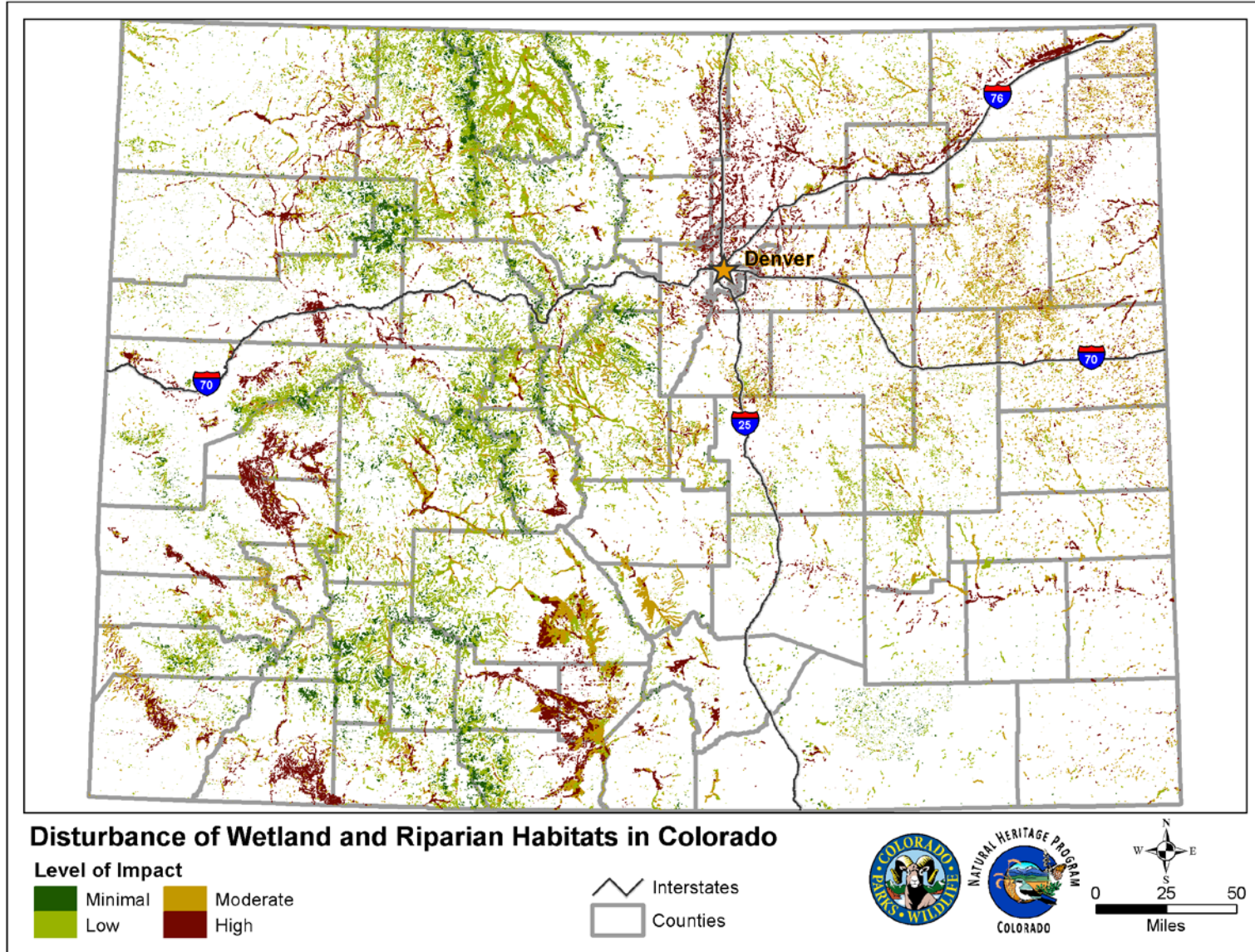


Figure 16. Level of disturbance to wetland and riparian habitats. Due to the small size of many wetland and riparian habitats, the polygons have been exaggerated to be visible on this statewide map.

Terrestrial Upland Habitats

Rondeau et al. (2011) developed a map of distinct patches of matrix-forming and large patch ecological systems, derived from Southwest Regional GAP vegetation data layer. These ecological system patches are roughly equivalent to the terrestrial habitats as defined in this SWAP. These maps show comparative condition for discrete patches of each habitat type, according to biodiversity status scores originally developed for Rondeau et al. 2011. Components of biodiversity status are sub-scores for patch size, patch condition, landscape context, and landscape integrity. General methods described below are summarized from Rondeau et al. 2011.

Habitat Patches

CNHP used the Southwest Regional Gap Analysis Project (SWReGAP) landcover dataset (USGS 2004) to produce a generalized vegetation map from which we could identify discrete ecological system patches. To the generalized map, we then added current highway data to represent existing fragmentation of the landscape. Of the resulting discrete patches of each ecological system type, we retained only patches larger than the minimum size judged to be viable as an ecological system at the landscape scale, according to methods in Rondeau (2001) and CNHP (2005a).

Size

Patches that met minimum size criteria were scored from 5 to 10, depending on size (Table 14). Patches that did not meet minimum size requirements were not included as viable in Rondeau et al. 2011. However, they have been added to these maps (Figures 17 - 19) and ranked as "Poor" without regard to the other sub-scores.

Table 14. Total acres, minimum patch size, number of patches, and largest patch size for each habitat.

Habitat Type	Habitat Name	Total acres	Minimum patch size (ac.)	No. patches	Largest patch (ac.)
Forest	Aspen	3,580,854	20,000	1,564	513,422
Forest	Lodgepole	2,199,719	30,000	643	264,169
Forest	Mixed Conifer	881,470	2,500	1,562	39,416
Forest	Pinyon-Juniper	6,753,665	30,000	1,300	512,906
Forest	Ponderosa	3,220,299	30,000	1,153	516,244
Forest	Spruce-Fir	4,880,993	20,000	956	458,277
Grass	Grasslands	3,020,774	5,000	1,551	281,180
Grass	Shortgrass	11,855,161	50,000	1,827	1,072,828
Other	Alpine Tundra	1,681,811	10,000	480	250,971
Shrub	Montane-Foothills Shrub	388,143	1,000	562	43,507
Shrub	Greasewood	443,159	1,000	367	136,846
Shrub	Oak & Mixed Mtn Shrub	2,717,457	5,000	1224	206,256
Shrub	Sagebrush	5,564,595	30,000	1,995	924,242
Shrub	Saltbush	763,237	1,000	356	77,768
Shrub	Sandsage	1,959,449	14,000	672	179,704
Shrub	Semi-desert Steppe	776,043	5,000	243	172,992

Patch Condition

Patch condition was scored by using the LANDFIRE Fire Regime Condition Class dataset (USFS 2007) that maps degree of departure from historic fire regime. The fire condition metric is most meaningful for forests, but was included for all habitats except alpine, greasewood, salt shrub, and shrub-steppe. This metric was judged to be not meaningful for these habitats because alpine does not typically burn, and LANDFIRE dataset does not represent these three shrubland types well. The Condition sub-score in Rondeau et al. 2011 only reflected degree of departure from normal fire regime. Since that analysis was completed, Colorado has experienced a number of significant insect outbreaks and wildfires. Thus, for forest habitats, the condition sub-score was updated by incorporating degree of tree mortality due to insect infestation and disease as mapped by the U.S. Forest Service aerial surveys from 2008-2014. While not added to the sub-score, the aerial extents of recent large-scale fires and mud-slides (2012-2014, Rocky Mountain Incident Management data) were overlaid on ecosystem patches as a highly transparent white, so they

would lighten the color (and therefore the apparent condition) just for the footprint of the disaster, and not the ecosystem patch as a whole.

Landscape Context and Integrity

Landscape context was scored by calculating the proportion of the landscape within ½ mile of a patch that is covered with natural vegetation. Landscape integrity was calculated using a GIS layer that represents the cumulative impacts from oil and gas wells, gas pipelines, surface mines, urban development, agriculture, roads, transmission lines, and wind turbines (i.e., the Landscape Integrity map, Figure 15, in this chapter).

Overall Biodiversity Status

The four sub-scores were averaged to produce the biodiversity status scores, which are used to represent the overall habitat condition presented on Figures 17-19. These scores, ranging from 0 to 10, have been classified as:

0 - 2.5	Poor
> 2.5 - 5.0	Fair
> 5.0 - 7.5	Good
> 7.5 - 10	Very Good

For these maps, the patch condition and landscape integrity sub-scores from Rondeau et al. 2011 were updated with new information and the biodiversity status score re-calculated.

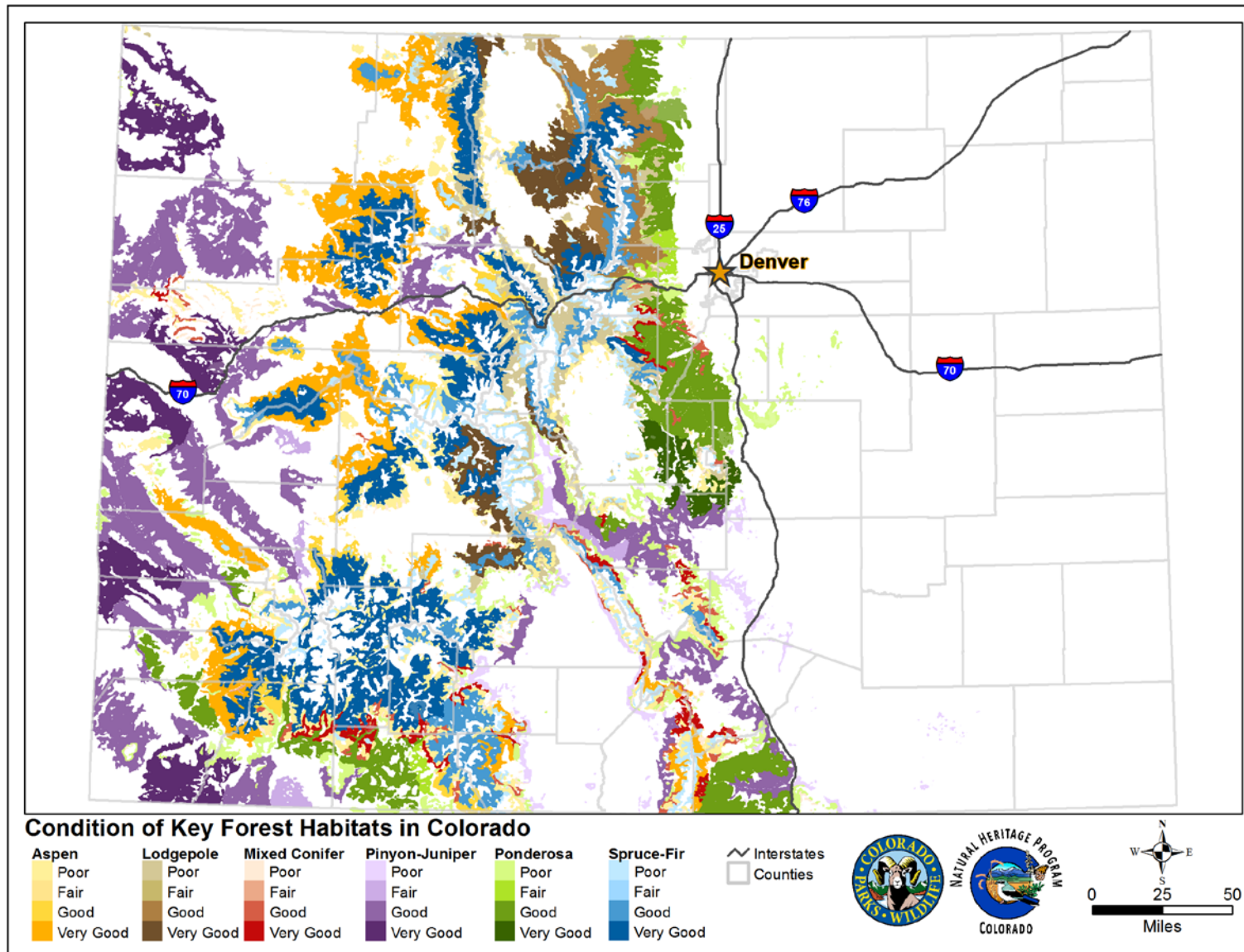


Figure 17. Terrestrial upland habitat condition - Forests.

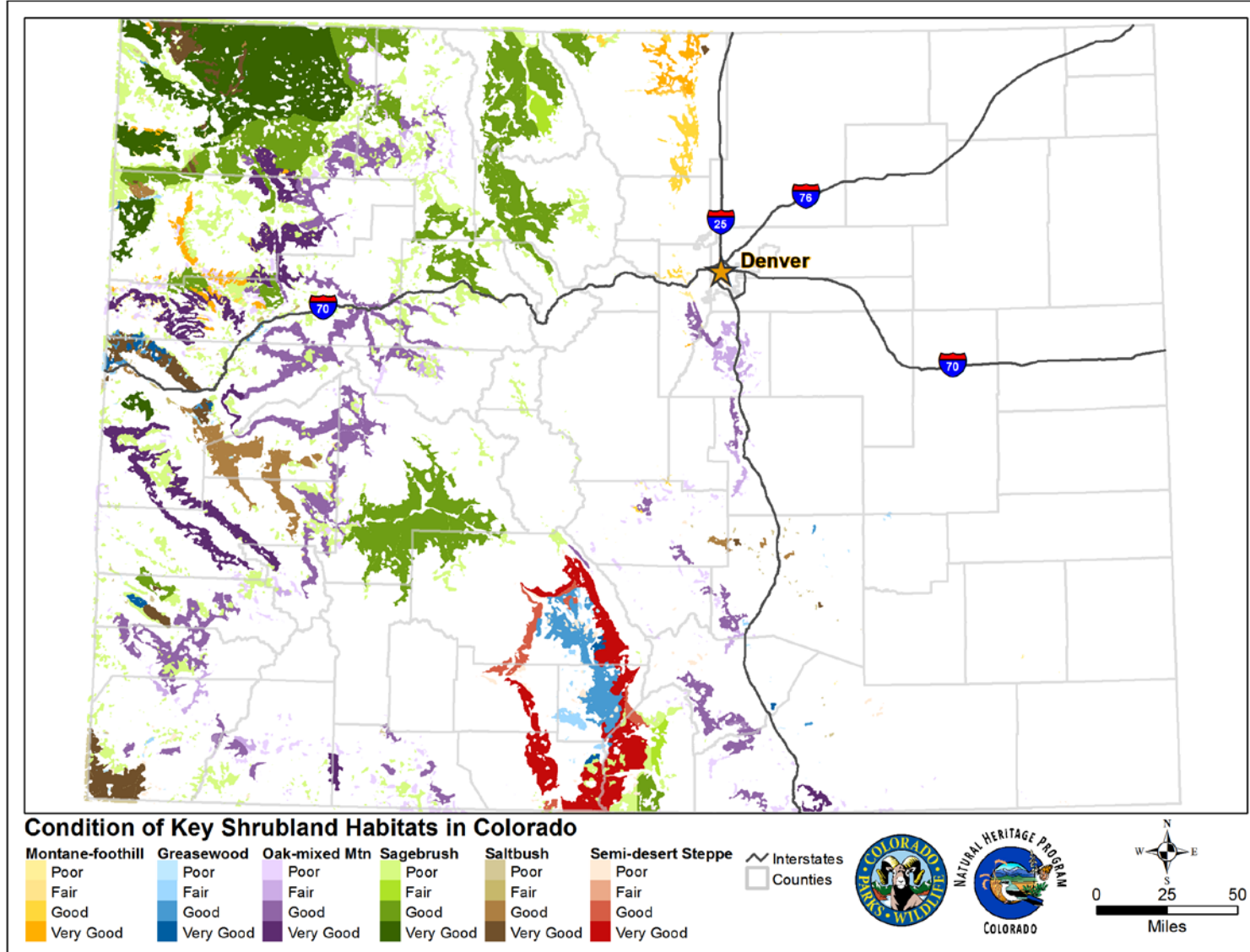


Figure 18. Terrestrial upland habitat condition – Shrublands

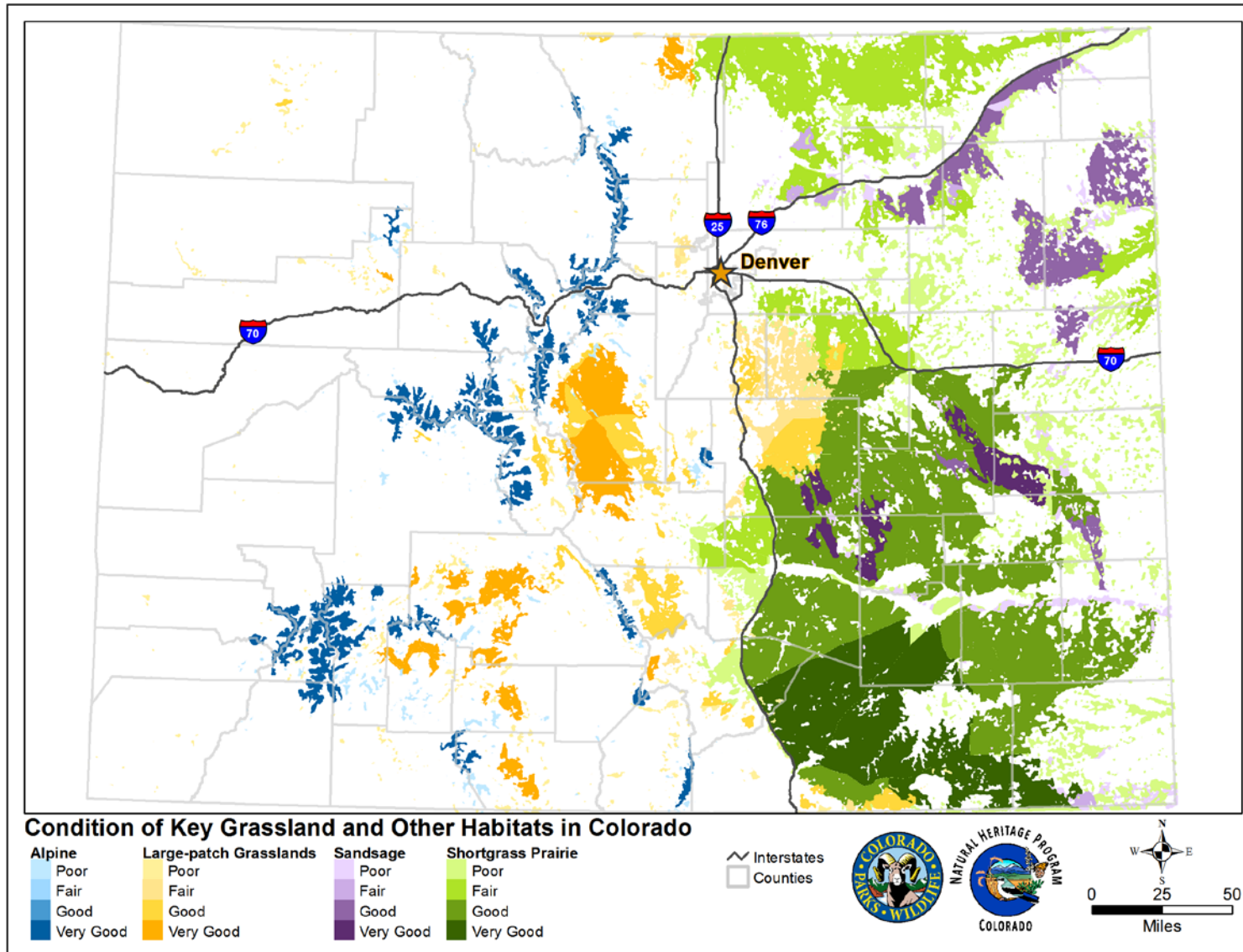


Figure 19. Terrestrial upland habitat condition – Grasslands and Other Habitats

High Priority Watersheds for Aquatic SGCN

This map represents the number of Tier 1 fish species known to occur in each HUC10 watershed in the state, according to data available in CPW's fish database as of December 2014 (Figure 20). There are 25 fish species on the Tier 1 SGCN list; a maximum of eight different species occur in the same watershed. This map is an indicator of species richness only; it does not consider relative habitat quality, or population metrics such as density or abundance, across watersheds.

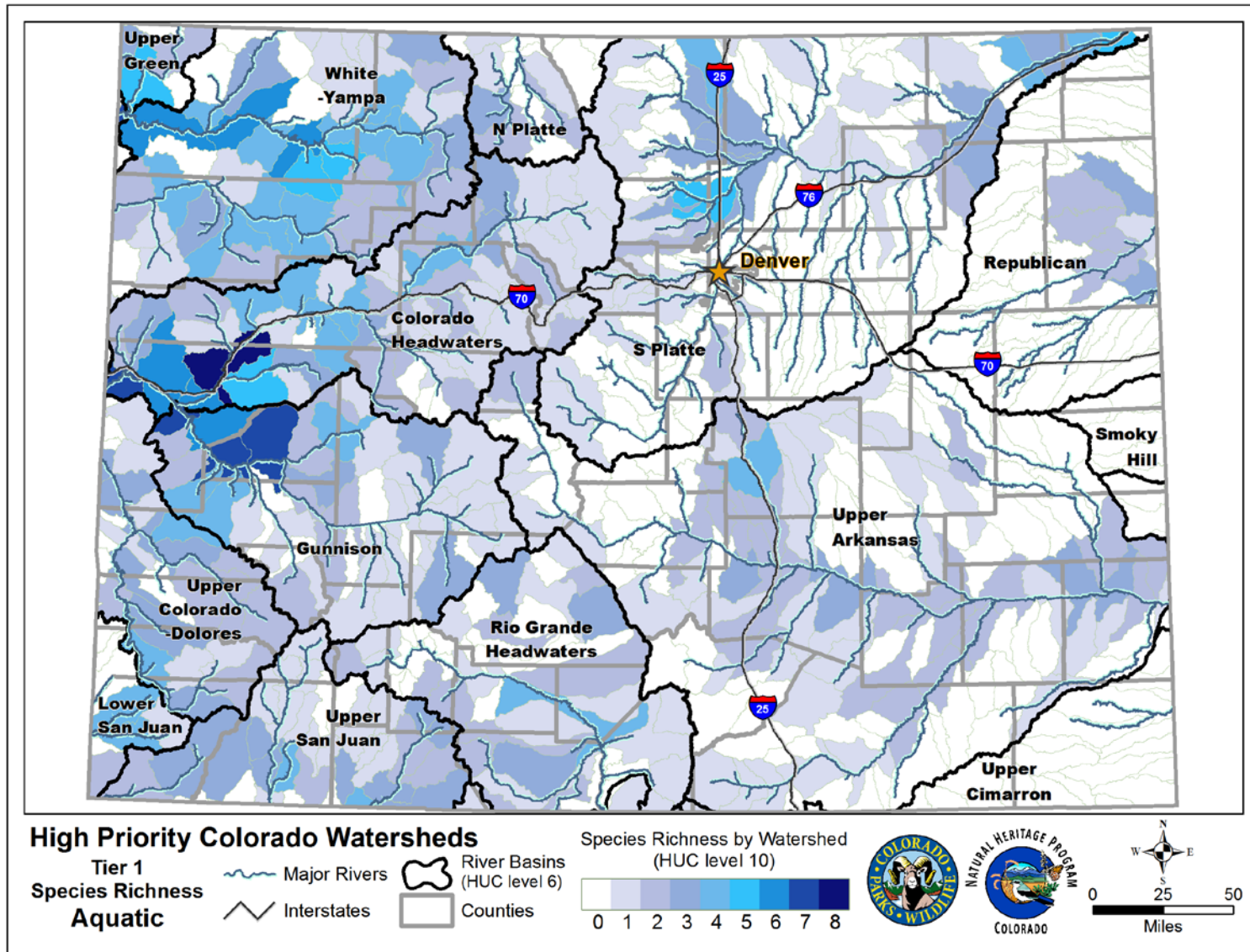


Figure 20. Priority watersheds for aquatic Tier 1 SGCN.

Crucial Habitat Assessment Tool

The first iteration of the Crucial Habitat Assessment Tool²⁴ (CHAT) map was developed in 2013, in collaboration with the Western Governors' Association and 18 other states, for the purpose of creating a regional spatial data tool to identify crucial wildlife habitat across the western U.S. As part of Colorado's CHAT effort, a map of Species of Greatest Conservation Need was developed. The original SGCN CHAT layer for Colorado has been updated to reflect the newly revised list of Tier 1 SGCN, and to incorporate improved distribution data for those species (Figure 22). Using State Wildlife Grant funds, we developed species distribution models for 16 Tier 1 SGCN. These newly-developed models, pre-existing species distribution models, and documented distribution data for Tier 1 terrestrial vertebrate and plant SGCN have been combined at the resolution of 640 acre hexagons across the state. Each hexagon was then placed into one of five habitat priority categories based on criteria listed in Table 15.

As defined by the Western Governors' Wildlife Council (2013), crucial habitats are places containing the resources, including food, water, cover, shelter and important wildlife corridors, that are necessary for the survival and reproduction of aquatic and terrestrial wildlife and to prevent unacceptable declines, or facilitate future recovery of wildlife populations, or are important ecological systems with high biological diversity value. Crucial habitats are categorized according to the following definitions using the criteria in Table 15. See Table 16 for criteria as applied for each SGCN.

Category 1: Habitats, including wildlife corridors, that are rare or fragile and are essential to achieving and/or maintaining wildlife species viability or exceptional diversity. The habitat contains a unique combination of location or composition or complexity of the habitat or corridor which cannot be duplicated, and is therefore considered irreplaceable.

Category 2: Habitat, including wildlife corridors, which is limiting to a fish or wildlife community, population, or metapopulation. Loss of any of this habitat or corridor could result in a significant local or population-level decline in species distribution, abundance, or productivity. The habitat or corridor is essential to achieving and maintaining fish and wildlife target population or management objectives. Restoration or replacement is difficult, or may be possible only in the very long term.

Category 3: Habitat, including wildlife corridors, that contributes significantly to the maintenance of fish or wildlife communities, populations, or metapopulations. Loss of a significant portion of the habitat or corridor could result in local or population-level declines in

²⁴ <http://westgovchat.org>

species distribution, abundance, or productivity. Impacts can be minimized or reduced, and habitat or corridors restored or replaced by utilizing appropriate best management practices.

Common Habitat [represented on map as Category 4]: Habitat which is relatively common, generally less limiting to fish and wildlife communities, populations, or metapopulations, and generally better suited for land use conversion. Large-scale or cumulative impacts to species or habitat could result in declines in species distribution or abundance, however, the loss may be difficult to measure. Impacts from individual projects or land use actions can be minimized, and habitat restored or replaced, so that effective habitat function or species distribution or abundance is maintained.

Habitat Significance Unknown [represented on map as Category 5]: Lands likely to have significant wildlife values, but for which there is insufficient data or a lack of information about the importance of the habitat in meeting conservation objectives.

Table 15. Criteria for CHAT categories.

Federal listing codes: LE = Endangered; LT = Threatened, C = Candidate; NatureServe conservation status codes: G1= critically imperiled; G2 = imperiled; G3 = vulnerable; G4 = apparently secure; G5 = demonstrably secure.

CHAT Category	Criteria
1	At least one T, E, G1, or G2 species with documented occurrence, or at least two G3 species with documented occurrence
2	At least one document occurrence of a C or G3 species, or at least two documented occurrences of G4 species
3	Modeled distribution of at least one G3 species, or documented occurrence of at least one G4 species
4	Modeled distribution of at least one C or G4 species, or documented occurrence of at least one G5 species
5	Modeled distribution of at least one G5 species

Table 16. CHAT categorization criteria, by species.

Species	Federal Listing Status	NatureServe Status Rank	Documented Occurrence	Modeled Distribution
TIER 1 AMPHIBIANS				
Boreal toad		G1	X	X
Northern leopard frog		G5	X	X
TIER 1 BIRDS				
Brown-capped rosy-finch		G4	X	X
Burrowing owl		G4	X	X
Columbian sharp-tailed grouse		G3	X	X
Golden eagle		G5		X
Greater sage grouse	C	G3	X	X
Greater sandhill crane		G4	X	X
Gunnison sage grouse	LT	G1	X	X
Lesser prairie-chicken	C	G3	X	X
Mountain plover		G3	X	X
Plains sharp-tailed grouse		G4	X	X
Southern white-tailed ptarmigan		G5	X	X
Southwestern willow flycatcher	LE	G1	X	X
Western yellow-billed cuckoo	LT	G4		X
TIER 1 MAMMALS				
American pika		G5		X
Black-footed ferret	LE	G4		X
Fringed myotis		G4	X	X
Gunnison's prairie dog	C	G5	X	X
Little brown myotis		G4		X
Lynx	LT	G4		X
New Mexico meadow jumping mouse		G4		X
Olive-backed pocket mouse		G5		X
Preble's meadow jumping mouse	LT	G2	X	X
Spotted bat		G4	X	X
Townsend's big-eared bat subsp.		G3	X	X
White-tailed prairie dog		G4	X	X
Wolverine		G4		X
TIER 1 REPTILES				
Colorado checkered whiptail		G2	X	X
Massasauga	C	G3	X	X
TIER 1 PLANTS				
<i>Aletes latilobus</i>		G1	X	
<i>Aliciella sedifolia</i>		G1	X	
<i>Astragalus deterior</i>		G1	X	
<i>Astragalus humillimus</i>	LE	G1	X	

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Species	Federal Listing Status	NatureServe Status Rank	Documented Occurrence	Modeled Distribution
<i>Astragalus microcymbus</i>	C	G1	X	
<i>Astragalus osterhoutii</i>	LE	G1	X	
<i>Astragalus schmolliae</i>	C	G1	X	
<i>Astragalus tortipes</i>	C	G1	X	
<i>Boechera glareosa</i>		G1	X	
<i>Corispermum navicula</i>		G1	X	
<i>Descurainia kenheili</i>		G1	X	
<i>Draba malpighiacea</i>		G1	X	
<i>Draba weberi</i>		G1	X	
<i>Erigeron wilkenii</i>		G1	X	
<i>Eriogonum brandegeei</i>		G1	X	
<i>Eriogonum pelinophilum</i>	LE	G2	X	
<i>Eutrema penlandii</i>	LT	G1	X	
<i>Gutierrezia elegans</i>		G1	X	
<i>Hackelia gracilentia</i>		G1	X	
<i>Ipomopsis polyantha</i>	LE	G1	X	
<i>Ipomopsis ramosa</i>		G1	X	
<i>Lepidium huberi*</i>		G1		
<i>Lygodesmia doloresensis</i>		G1	X	
<i>Mimulus gemmiparus</i>		G1	X	
<i>Oenothera coloradensis ssp. coloradensis</i>	LT	G2	X	
<i>Oreoxis humilis</i>		G1	X	
<i>Packera mancosana</i>		G1		
<i>Pediocactus knowltonii*</i>		G1		
<i>Penstemon debilis</i>	LT	G1	X	
<i>Penstemon gibbensii</i>		G1	X	
<i>Penstemon penlandii</i>	LE	G1	X	
<i>Penstemon scariosus var. albifluvis</i>	C	G1	X	
<i>Phacelia formosula</i>	LE	G1	X	
<i>Phacelia submutica</i>	LT	G2	X	
<i>Physaria congesta</i>	LT	G1	X	
<i>Physaria obcordata</i>	LT	G1	X	
<i>Physaria pulvinata</i>		G1	X	
<i>Physaria rollinsii</i>		G1	X	
<i>Physaria scrotiformis</i>		G1	X	
<i>Sclerocactus glaucus</i>		G2	X	
<i>Sclerocactus mesae-verdae</i>	LT	G2	X	
<i>Spiranthes diluvialis</i>	LT	G2	X	

* No locational data for these species exist for Colorado, so they are not represented on the CHAT map.

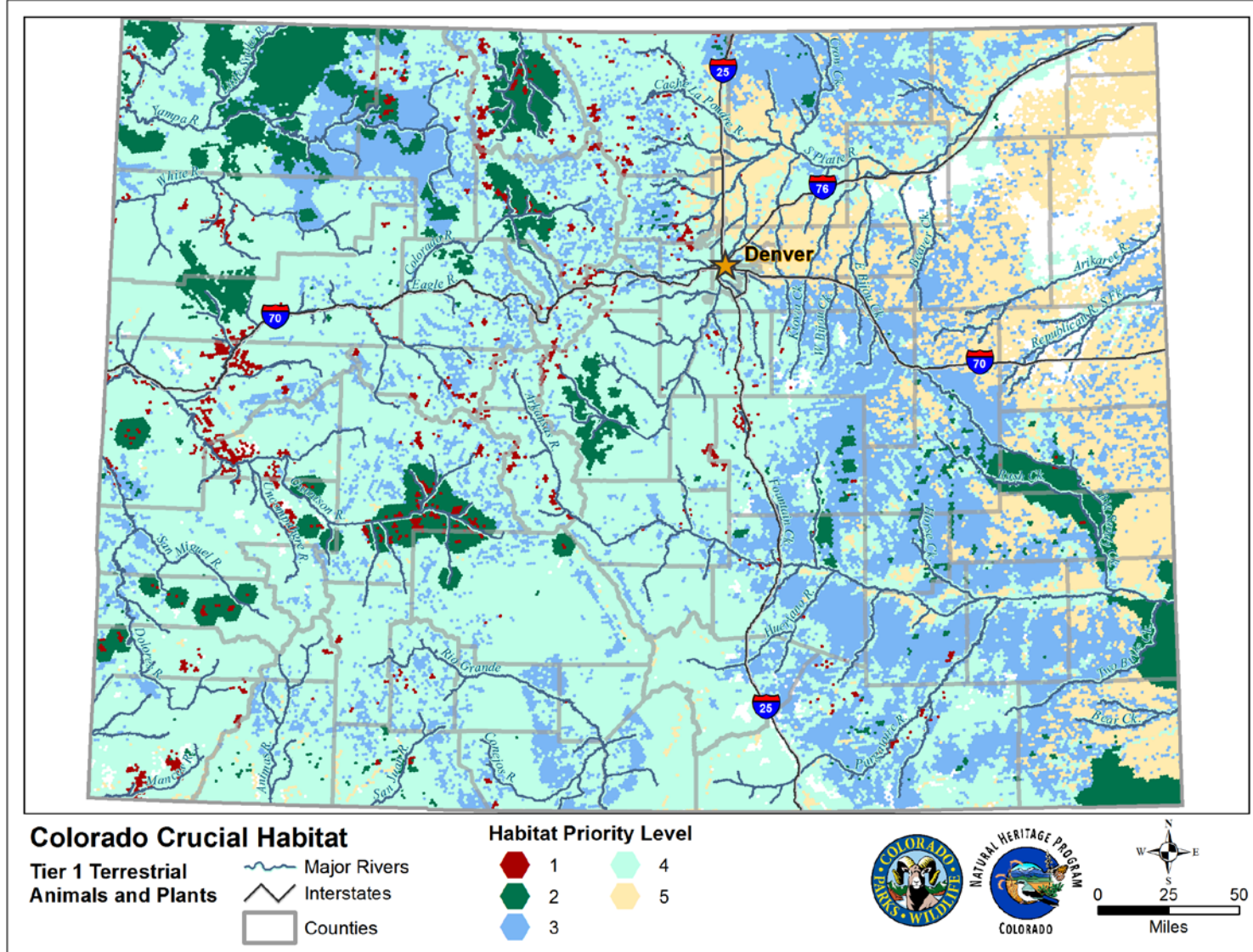


Figure 21. Crucial habitat for Tier 1 terrestrial animal and plant SGCN. Areas in white on the map indicate places where there are no documented occurrences or modeled habitat for any Tier 1 SGCN.

Chapter 9: Review, Coordination, and Public Participation

Review and Updates to the SWAP

Guidance provided by USFWS and the AFWA *Best Practices for State Wildlife Action Plans* document for updating SWAPs distinguishes between major revisions and minor revisions. Major revisions include any change to the SGCN list or the threats assessment, or any change that could result in changes to conservation actions or their priority. We have generated our SGCN list and the subsequent analyses with an eye to potential changes in conservation issues over the next decade. Thus, we do not anticipate the need to conduct major revisions over the 10-year life of this plan. If that need were to occur, we would follow USFWS guidance in conducting major revisions. Meanwhile, as new information becomes available relative to required SWAP elements, it will be incorporated into the SWAP database for use in the next scheduled SWAP update.

Partner Coordination & Public Participation

Development of the 2006 SWAP was a multi-pronged approach that engaged technical experts and general stakeholders separately. This was an appropriate approach at the time because SWAPs were a new concept that required a greater level of philosophical exploration and understanding by all parties than is needed today. Also, the 2006 SWAP was the first statewide, strategic wildlife conservation plan intended for use by all relevant parties ever developed for Colorado.

Over the past decade, familiarity with and use of the SWAP has become routine by many agencies, conservation partners, and stakeholders. Colorado is fortunate to have a relatively well-connected community of conservation practitioners, with a great deal of cross-over in terms of scientific and/or land management expertise among agencies and NGOs. This, combined with the fact that the development of the 2015 SWAP was a revision of an existing document, as opposed to a “starting from scratch” effort, negated the need to distinguish between technical experts and other stakeholders. Thus, we focused the majority of our public participation efforts on improving the scientific content rather than conducting in-person general public information activities. To better facilitate involvement by all interested parties, we organized our collaboration efforts around online participation, as described below.

Stakeholder Identification

During the SWAP revision process, we developed a list of almost 400 stakeholders that included representatives from all levels of government, as well as non-governmental organizations, Native American tribes, the private sector, interest groups, and private citizens (Table 17). This list included all those who participated in the development of the 2006 SWAP, agency and NGO scientists and land managers identified by CPW staff as important collaborators, members of the Colorado Sportsmen's Roundtable, and many others. On May 9, 2014, a press release was published notifying the public of the SWAP revision process, and inviting participation. All who responded to this notice with a request to be added to the stakeholder list were included. Table 17 presents a tally of the number of stakeholder representatives by organization type. A full list of stakeholder agencies and organizations is included in Appendix H.

Table 17. Summary of stakeholders by organization type.

Partner/Stakeholder Category	Number of Representatives
Federal Agencies	79
State Agencies (not including CPW)	13
Local Governments	27
Native American Tribes	2
Non-governmental Organizations	135
Universities	48
Private Consulting Firms	28
Private Citizens	61
Industry	1

Stakeholder Comment Opportunities

To support broad public participation, CPW created a dedicated webpage on the Colorado Parks and Wildlife homepage²⁵ as well as a dedicated email address for direct communication with stakeholders. The SWAP webpage hosted background information on the SWAP, and instructions for stakeholder involvement in the revision process. All review drafts of SWAP

²⁵<http://cpw.state.co.us/aboutus/Pages/StateWildlifeActionPlan.aspx>

components were posted for public access, and emailed directly to all stakeholders on the SWAP distribution list.

On June 9, 2014, an email was sent to all stakeholders inviting them to join a SWAP revision kick-off webinar. The purpose of the webinar was to introduce the revision process, to alert stakeholders to the scheduled comment periods, and to explain the procedures for submitting comments. The webinar was recorded and posted to the SWAP webpage for stakeholders who were unable to attend the original webinar.

Stakeholders had four opportunities to provide comments on draft components of the SWAP, and one opportunity to provide final comments on the draft SWAP in its entirety, according to the schedule presented in Table 18. The emails inviting stakeholder input for each comment period are included in Appendix I. After each review period, stakeholder comments were compiled and summarized, along with CPW responses to each comment. These summaries were then posted on the SWAP webpage to allow stakeholders to track the development of each SWAP chapter.

Colorado's 2015 State Wildlife Action Plan

Table 18. Schedule of SWAP revision milestones and stakeholder comment opportunities.

Colorado's SWAP Revision Process	2014										2015								
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Element 1: SGCN																			
CPW review	■	■																	
Draft chapter prep		■	■	■															
Stakeholders comment				■	■														
Element 2: Habitats																			
CPW review			■	■															
Draft chapter prep				■	■	■													
Stakeholders comment						■	■												
Elements 3 and 4: Threats and Conservation Actions																			
CPW review					■	■	■	■											
Draft chapter prep								■	■	■	■								
Stakeholders comment										■	■								
Element 5: Monitoring & Measures of Success																			
CPW review											■	■							
Draft chapter prep												■	■						
Stakeholders comment													■	■					
Draft SWAP Prep																			
DRAFT SWAP prep		■	■	■	■	■	■	■	■	■	■	■	■	■					
CPW LEADERSHIP REVIEW													■	■					
FINAL DRAFT prep													■	■	■				
CPW review															■	■			
Stakeholders comment															■	■			
Finalization Phase																			
FINAL SWAP prep																■	■		
CPW Leadership Approval																		■	
Delivery to USFWS																		■	

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PREPARED FOR THE CITIZENS OF COLORADO AND ITS VISITORS
BY COLORADO PARKS AND WILDLIFE

State Wildlife Action Plan Appendices

A STRATEGY FOR CONSERVING WILDLIFE IN COLORADO



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Appendix A: Rare Plants

Colorado Wildlife Action Plan

Appendix A: Rare Plants



By the Colorado Natural Heritage Program

For

Colorado Parks and Wildlife

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Cover photos: Background – shortgrass prairie (Renée Rondeau); foreground – *Asclepias uncialis* (Jill Handwerk).

EXECUTIVE SUMMARY

The purpose of this Addendum to Colorado's State Wildlife Action Plan (SWAP) (CPW 2015) is to set a statewide strategic direction for the conservation of Colorado's most imperiled plant species and their habitats, and to establish a coordinated statewide approach for partners working on rare plant conservation. The Colorado Rare Plant Conservation Initiative (RPCI) compiled the original information in this document, and developed much of the conservation strategy reflected in the contents herein, to set a conservation direction for Colorado's imperiled plants and their habitats. This Addendum, and the Colorado Rare Plant Conservation Strategy upon which it is based (Neely et al. 2009), represent a collective vision for plant conservation in Colorado, emphasizing a proactive approach to ensure the long-term stewardship and viability of Colorado's rarest plants. When implemented, this plan will enable concerned partners to systematically and meaningfully advance urgently needed plant conservation in Colorado, thus avoiding the need for federal listings.

Using the RPCI Strategy as a starting point, botanists and planners from CNHP, CNAP, and TNC developed the components of the 2011 Draft Addendum. Draft components were circulated among all RPCI members for review and revision. For this 2015 version, the Draft Addendum was thoroughly reviewed to reflect recent advances in nomenclature, for currentness of content, and to reflect on the ground changes. Eleven species were added to the list, 17 species underwent name or rank changes but remained on the list, and 15 species were removed which had taxonomic uncertainty or were found to be more common than previously thought. Further, the development of this Addendum was guided by the eight required elements set forth in the U.S. Fish and Wildlife Service's guidance on State Wildlife Action Plans.

Plants of Greatest Conservation Need

Plants of Greatest Conservation Need (PGCN) are defined as the 117 critically imperiled and imperiled plant species in Colorado. These are globally rare species with NatureServe Conservation Status ranks of G1 (critically imperiled) and G2 (imperiled). These species are considered to be at risk throughout their range and vulnerable to extinction. Rare plant experts within RPCI prioritized this list into Tier 1 species and Tier 2 species (Table 1, Figure 1):

Tier 1 Plants of Greatest Conservation Need – all G1 species, all federally listed species;

Tier 2 Plants of Greatest Conservation Need – all G2 species not federally listed.

Key Habitats

Colorado's imperiled plants occur within eight major habitat types: *alpine, barrens, cliffs and canyons, grasslands, forests, pinyon-juniper woodlands, shrublands, and wetlands* (CNHP 2014; CNHP and TNC

2011; Colorado Native Plant Society 1997). Colorado's barrens and shrublands are especially rich habitats for imperiled plant species, followed by pinyon-juniper woodlands, cliffs and canyons, and alpine habitats (CNHP 2014, CNHP and TNC 2011). Shrublands are Colorado's most important habitat for rare plants (supporting 24% of the imperiled species), occupying 19% of the state's acreage. Barrens occupy less than 1% of Colorado, but 20% of our rarest plants are primarily associated with barren habitats. Pinyon-juniper woodlands, cliffs and canyons, and alpine habitats combined provide habitat for nearly 40% of the rare plant species (Figures 2 and 3). Mapping of habitat types is from SWReGAP (Prior-Magee et al. 2007; USGS 2004).

Conservation Issues

Colorado's irreplaceable native plants, plant communities, and ecosystems are thus increasingly being threatened. Most of Colorado's imperiled plants are naturally rare. They are rare because they are restricted to very specific, narrowly distributed habitats, rather than as a result of human actions, *per se*. However, because these species occupy such small areas, planning is necessary to avoid placing these species at further risk from human activities. Degradation, fragmentation, and loss of habitat are major reasons plant species and their habitats are imperiled or vulnerable in Colorado. The primary contributors to habitat degradation for imperiled plants are ***energy development, motorized recreation, residential development, and road construction and maintenance*** (CNHP and TNC 2011). Other risk factors include altered hydrologic regime, invasive species, agricultural development, loss of pollinators, incompatible grazing/trampling, and plant collecting (CNHP and TNC 2011). Additionally, there is strong scientific consensus that human-induced climate change is affecting species and ecological systems, and this is likely to exacerbate the effects of other human activities on plants (Enquist and Gori 2008).

One of the biggest issues is a ***lack of awareness*** and information regarding the presence, distribution, and precarious status of Colorado's native and imperiled plant species. Many rare plants inhabit small areas, have specialized needs, and have unique habitat requirements that are often missed by other approaches to conservation (e.g., those focused primarily on wildlife).

Conservation Objectives

The following statewide conservation objectives, adapted from the RPCI Rare Plant Conservation Strategy, are necessary to meet the conservation needs of Colorado's PGCN. These objectives represent the most urgent and critical actions needed to effectively conserve Colorado's imperiled plant species. These objectives will guide conservation activities and catalyze collaborative conservation action over the next decade.

The following Objectives and Conservation Actions are statewide in scope, and are applicable to all PGCN. Part 5, Table 3 presents specific, prioritized conservation actions on a species-by-species basis.

The six statewide conservation objectives are:

1. ***Secure on-the-ground, site-specific habitat protection and/or management*** to achieve specific goals for all of Colorado's imperiled plants on public and private lands. Focus these activities in places that are likely to remain stable under predicted climate change scenarios, and on areas needed to maintain habitat connectivity (e.g., to facilitate climate-related distributional shifts).
2. ***Minimize threats*** from specific land uses that impact many of Colorado's imperiled plants statewide, and ***develop climate change adaptation strategies*** for vulnerable species.
3. ***Improve scientific understanding*** of the distribution, natural history, response to climate change, and status of Colorado's most imperiled plants through inventory, research, and monitoring.
4. ***Develop and implement a state program and policies*** to enhance the conservation of Colorado's most imperiled plants in cooperation with public land managers, private landowners, and other interested stakeholders.
5. ***Facilitate the stewardship*** of Colorado's most imperiled plants through education, outreach, and coordination.
6. ***Adopt measures for the ex situ (off site) conservation*** of Colorado's most imperiled plants in case native populations are extirpated due to stochastic events, anthropogenic impacts, and/or climate change.

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INTRODUCTION

The purpose of this Addendum to Colorado's State Wildlife Action Plan (CPW 2015) is to set a statewide strategic direction for the conservation of Colorado's most imperiled plant species and their habitats, and to establish a coordinated statewide approach for partners working on rare plant conservation. The Colorado Rare Plant Conservation Initiative (RPCI) compiled the information in the original 2011 draft of this document, and developed much of the conservation strategy reflected in the contents herein, to set a conservation direction for Colorado's imperiled plants and their habitats. In 2014-2015 the Colorado Natural Heritage Program, revised the 2011 draft to reflect the current conservation status of Colorado's rare plants. This Addendum, and the Colorado Rare Plant Conservation Strategy upon which it is based, represent a collective vision for plant conservation in Colorado, emphasizing a proactive approach to ensure the long-term stewardship and viability of Colorado's rarest plants. When implemented, this plan will enable concerned partners to systematically and meaningfully advance urgently needed plant conservation in Colorado, thus avoiding the need for federal listings.

The Rare Plant Conservation Initiative

The Rare Plant Conservation Initiative is a diverse partnership of state and federal agencies, private organizations, academic institutions, and individuals concerned with the stewardship and survival of imperiled plants in Colorado (see Appendix E for list of RPCI members). The RPCI grew out of the Colorado Rare Plant Technical Committee (RPTC), a statewide group of botanists, ecologists, and planners that have been meeting regularly since 1992 to exchange information, assess plant species conservation status, and identify and prioritize management and stewardship actions for plants. In 2007, the group determined that there was a growing need to improve coordination and take proactive steps to address rapidly increasing impacts to rare plants in Colorado. This Initiative has built on previous RPTC and partnership efforts, including the Colorado Rare Plant Field Guide (Spackman et al. 1997), Rare Plants of Colorado (Colorado Native Plant Society 1997), on-the-ground conservation of imperiled plants in the Adobe Hills and Arkansas Valley, Annual Colorado Rare Plant Symposia, Colorado Natural Areas Program (CNAP) designations, U.S. Forest Service species assessments, and the Denver Botanic Gardens (DBG) monitoring projects. The RPCI is committed to achieving results through a collaborative approach that is based on the best available science, close coordination, data sharing, and taking strategic action.

RPCI and the Development of this Addendum

In 2009, the RPCI published their Colorado Rare Plant Conservation Strategy (Strategy). This was a collaborative effort among many partners, and represents the collective knowledge, expertise, and priorities of all major agencies, non-profits, and educational institutions involved in conservation of Colorado's rarest plants. The Strategy was thoroughly vetted by Colorado's rare plant conservation community, and presents a summary of status, threats, and conservation goals and objectives for 121 of Colorado's rarest plant species.

Chief among the conservation objectives that RPCI has identified for rare plants is the need for focused state-level conservation. They identified the incorporation of rare plants into Colorado's SWAP as one significant step to take in that direction. To that end, RPCI was instrumental in the preparation of this Addendum to Colorado's SWAP. This Addendum is closely based on the RPCI Strategy, and much of the information herein was taken directly from that document. The Addendum goes further, in that it:

- 1) makes direct links between specific plant species and species-level threats and conservation actions;
- 2) sets priorities for specific conservation actions on a species-by-species basis;
- 3) includes species-specific assessments of vulnerability to climate change; and
- 4) makes rare plant information, and the opportunity to review and comment on priority conservation actions, available to new audiences.

The Addendum Development Process

Using the RPCI Strategy as a starting point, botanists and planners from CNHP, CNAP, and TNC developed components of the draft Addendum. This 2015 revised Addendum was updated by CNHP in collaboration with CPW and CNAP. Components of both the 2011 draft and the revised 2015 Addendum were circulated among all RPCI members for review and revision. The development of this Addendum was guided by the eight required elements set forth in the U.S. Fish and Wildlife Service's guidance on State Wildlife Action Plans. Details of the process for addressing each required element are described in the following sections.

Element 1: Information on the distribution and abundance of species

In 2009 the RPCI Strategy identified the 121 plant species of greatest conservation need in Colorado (PGCN). However, since that time new information has been acquired for many of the PGCN resulting in the revision of the conservations status of several species and the refinement of the original list. Specifically; eleven species were added to the list, 17 species underwent name or rank changes but remained on the list, and 15 species were removed which had taxonomic uncertainty or were found to be more common than previously thought. We now have a total of 117 PGCN (Table 1). These are globally rare species with NatureServe Conservation Status ranks of G1 (critically imperiled) and G2 (imperiled). These species are considered to be at risk throughout their range and vulnerable to extinction. Rare plant experts within RPCI prioritized this list into Tier 1 species and Tier 2 species:

Tier 1 Plants of Greatest Conservation Need – all G1 species, all federally listed species;

Tier 2 Plants of Greatest Conservation Need – all G2 species not federally listed.

Information on distribution, population status, and trends for all PGCN was compiled from a variety of sources. Data sources included:

- 1) the Colorado Natural Heritage Program's conservation databases (Element Occurrence records, Element Tracking records, Element Rank Reports, and characterization abstracts);
- 2) Colorado's Biodiversity Scorecard (CNHP and TNC 2011);
- 3) U.S. Forest Service species assessments
(<http://www.fs.fed.us/r2/projects/scp/assessments/index.shtml>);
- 4) the Colorado Rare Plant Field Guide (<http://www.cnhp.colostate.edu/>);
- 5) published and unpublished literature, and herbarium collections;
- 6) expert opinion of Colorado's scientific community, via the RPCI and the NS network of Heritage Programs.

These data were compiled in an Access database to support data organization and reporting for this Addendum in the same format as the wildlife SWAP, as well as to allow for ease in future updating as new information becomes available. Distribution information is based primarily on CNHP's element occurrence database. Population status information is based on Colorado's Biodiversity Scorecard, and trend information is based on CNHP's Element Rank database. Where appropriate, these data were augmented or amended by expert review. Results are presented in Part 5 and Table 3 of this document.

Element 2: Locations and relative condition of key habitats

Colorado's SWAP addressed key habitats from a wildlife perspective. RPCI botanists reviewed this component of the SWAP for any additions necessary to complete the picture from a rare plant

perspective. One additional key habitat types was identified (barrens), and the habitat distribution map was adjusted to display all key rare plant habitats. The Access database was updated to reflect the plant species that occur in each habitat type, as well as the threats and conservation actions for the barrens habitat. These data were augmented, amended, and confirmed by expert review. Results are presented in Part 2 of this document and Chapter 6 of the full 2015 SWAP document.

Element 3: Issues that may adversely affect PGCN or their habitats, and priority research and survey efforts needed

The RPCI Strategy identified five significant issues that adversely affect many of the PGCN across Colorado: *energy development, motorized recreation, residential development, road construction and maintenance, and climate change*. In developing this Addendum, RPCI botanists consulted the data sources listed above to expand this list, and to provide more detail on a species-by-species basis. Plants that warrant significant research and survey efforts were also identified during this process. This information was captured in the same Access database used to compile distribution/abundance and habitat information for each PGCN (Part 5, Table 3). In order to capture similar concepts in as consistent a way as possible, we used a “Threats Taxonomy” to categorize threats in the Access database. The Threats Taxonomy in the 2011 draft was based on a taxonomy originally developed by The Nature Conservancy and adapted for use in the SWAP. In the interim, a standardized lexicon has been developed by the Conservation Measures Partnership (Salafsky et al. 2008), and is recommended in the 2012 Best Practices for State Wildlife Action Plans guidance (AFWA 2012). For the 2015 SWAP and Addendum, we have adopted the Salafsky lexicon’s classification of general threats (see Appendix A for the full classification). The database that was developed to house information on PGCN and habitats has been updated to reflect the new lexicon.

Because climate change is potentially a very significant issue for rare plants, we conducted a focused analysis on this topic using NatureServe’s Climate Change Vulnerability Index. The Index is an Excel-based tool that uses a scoring system to integrate species’ predicted exposure to climate change and three sets of factors associated with climate change sensitivity: 1) indirect exposure to climate change, 2) species-specific factors (including dispersal ability, temperature and precipitation sensitivity, physical habitat specificity, interspecific interactions, and genetic factors), and 3) documented response to climate change.

Content of the Access database and results of the CCVI analysis were submitted to stakeholders, including RPCI botanists, for expert review. Results are presented in Part 3 and Table 3, and Appendix Tables B1-B3 of this document. Details of CCVI methods are in Appendix B.

Element 4: Conservation actions necessary to conserve the PGCN and their habitats, and priorities for implementing

The RPCI Strategy identified six broad conservation objectives that are needed to conserve Colorado's PGCN, including land conservation and management, threat abatement, research, policy, education, and *ex situ* conservation. In developing this Addendum, RPCI used these broad objectives, as well as the data sources listed above, to identify specific conservation actions that are needed on a species-by-species basis, and to relate these actions directly to each species' most pressing threats. This information was captured in the same Access database used to compile distribution/abundance, habitat, and conservation issues information for each PGCN. In order to capture similar concepts in as consistent a way as possible, we used a "Conservation Actions Taxonomy" to categorize actions in the Access database (Appendix A). In the 2011 Addendum the Conservation Actions Taxonomy was based on a taxonomy originally developed by The Nature Conservancy, and adapted for use in the SWAP. In the interim, a standardized lexicon has been developed by the Conservation Measures Partnership (Salafsky et al. 2008). For the 2015 SWAP and Rare Plant Addendum, we have adopted the Salafsky lexicon's classification of conservation actions (see Appendix A for the full classification). The database that was developed to house information on PGCN and habitats has been updated to reflect the new lexicon.

Content of the database was submitted to stakeholders, including RPCI botanists for expert review. Results are presented in Parts and 5 and Table 3 of this document.

Element 5: Strategies for monitoring PGCN, their habitats, and the effectiveness of conservation actions

The monitoring strategies and objectives presented in this Addendum were taken from multiple sources including stakeholder review, the RPCI Strategy, and agency recommendations. They have been widely vetted by Colorado's botanical community, and represent a consensus on the steps needed to determine the status of Colorado's PGCN and identify early warning signs of declining trends. They are presented in Part 6 of this document.

Element 6: Procedures to review the Comprehensive Wildlife Conservation Strategy (referred to hereafter as "SWAP")

This element is tiered to the SWAP published in 2015. The next revision of that document is scheduled to begin in ten years. During that revision, we hope to update the content of this Addendum as necessary. The review process established in the SWAP is presented in Part 7 of this document.

Element 7: Coordination with federal, state, and local agencies and Native American Tribes

The stakeholder list of botanical experts in Colorado, including members of the Rare Plant Conservation Initiative was the primary means of coordination with federal, state, and local agencies on the development and content of this Addendum.

Element 8: Public participation

Agencies, technical experts, and non-governmental organizations have been engaged throughout the RPCI's efforts to develop their Conservation Strategy and this SWAP Addendum, as summarized in the Introduction section of this document. Stakeholders derived from the RPCI partnership (Appendix E) and the members of the Colorado Native Plant Society were invited to review the document at various stages throughout its development. These two groups represent over 700 individuals from all levels of government, as well as non-governmental organizations, the private sector, various interest groups, and private citizens.

Part 1: PLANTS OF GREATEST CONSERVATION NEED

In a comprehensive evaluation of the Colorado flora a total of 3,322 vascular plant species were documented to occur in Colorado; 2,797 of these were native, 108 of the native species are endemic to Colorado, and 527 species are non-native but variously naturalized (Ackerfield 2015). The plant families with the greatest number of rare plants in Colorado are the legume, sunflower, mustard, and figwort families. The Colorado Natural Heritage Program (CNHP) at Colorado State University currently tracks approximately 540 rare plant species in Colorado; of these, 117 species are ranked critically imperiled (G1) or imperiled (G2) on a global level. Sixty-eight of these are endemic to Colorado, occurring only here and nowhere else in the world. Another 115 species are considered vulnerable (ranked G3) (CNHP 2014). Nearly 70 of Colorado's plant species are on the BLM Sensitive Species List, and approximately 60 on the U.S. Forest Service Sensitive Species List. Currently, 16 Colorado native plant species are federally listed by the U.S. Fish and Wildlife Service as Threatened or Endangered; another three species are candidates for listing.

Plants of Greatest Conservation Need (PGCN) are defined as the 117 critically imperiled and imperiled plant species in Colorado. These are globally rare species with NatureServe Conservation Status ranks of G1 (critically imperiled) and G2 (imperiled). These species are considered to be at risk throughout their range and vulnerable to extinction. This list has been updated from the original 2009 RPCI and 2011 draft Addendum lists to reflect current knowledge, changes in nomenclature, and taxonomic uncertainty. Specifically; eleven species were added to the list, 17 species underwent name or rank changes but remained on the list, and 14 species were removed which had taxonomic uncertainty or were found to be more common than previously thought. Rare plant experts within RPCI prioritized this list into Tier 1 species and Tier 2 species (Table 1, Figure 1).

Tier 1 Plants of Greatest Conservation Need – all G1 species, all federally listed species;

Tier 2 Plants of Greatest Conservation Need – all G2 species not federally listed.

Table 1 lists all Tier 1 and 2 PGCN, along with each species' NatureServe global and state status ranks, federal agency status, and the extent of its range relative to Colorado's state boundary. Species are listed alphabetically by the scientific name used in Colorado (Weber and Wittmann 2012).

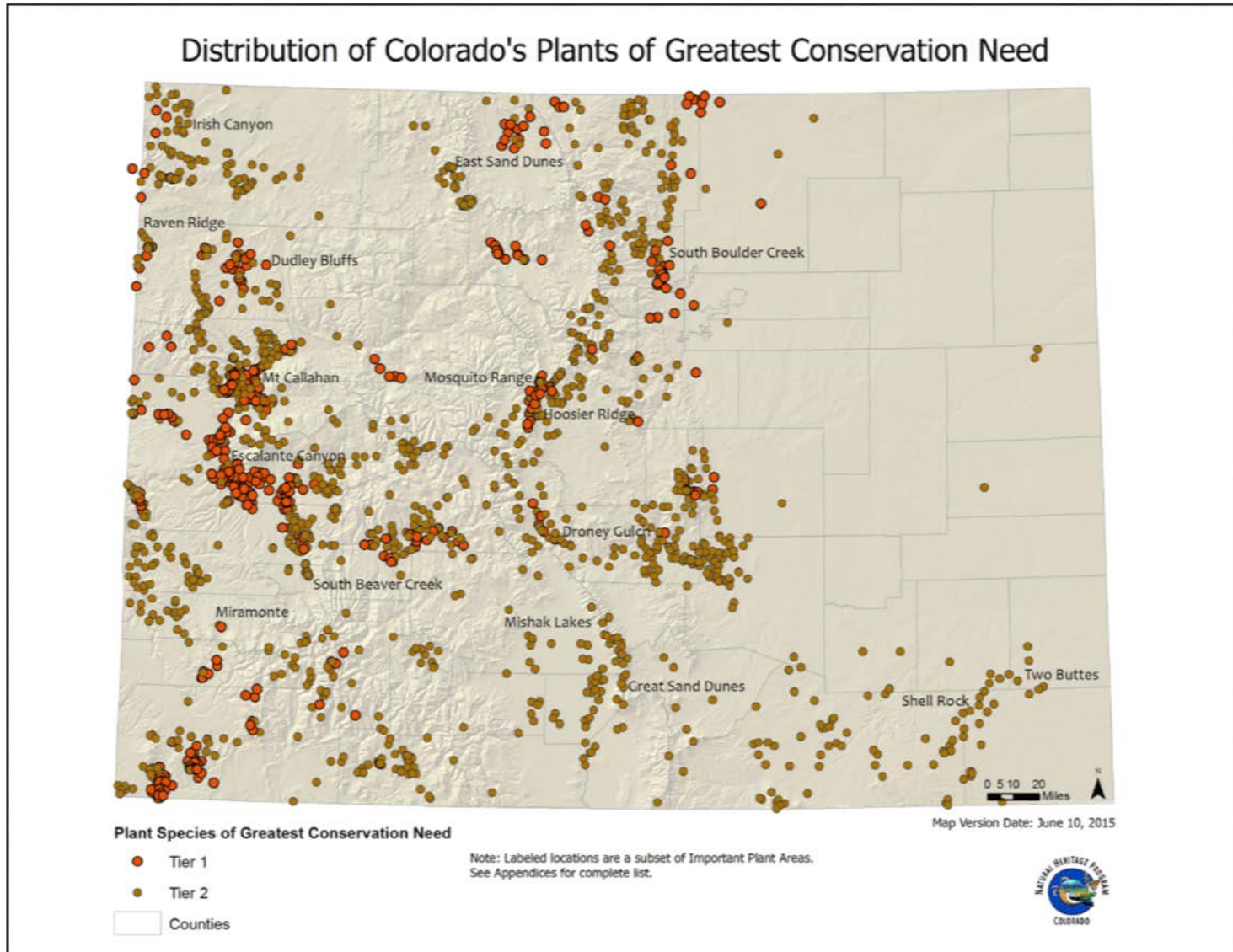


Figure 1. Map of Colorado showing distribution of Colorado's Plants of Greatest Conservation Need (Tier 1 and Tier 2 species).

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Table 1. Colorado Plants of Greatest Conservation Need

NatureServe status ranks are: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Demonstrably Secure; T = subspecies; Q = taxonomic question; SNA = Not Applicable (not in Colorado). Agency status indicates federal listing under the U.S. Endangered Species Act (LE = Listed Endangered; LT = Listed Threatened; C = Candidate for listing), and/or inclusion on the Sensitive Species lists of the Bureau of Land Management (BLM) Colorado Office or US Forest Service (USFS) Region 2. The percent of a species' range in Colorado is calculated as: Endemic = 100% of range within Colorado; Very High = 75-99% of range within Colorado; High = 50-75% of range within Colorado; Medium = 25-50% of range within Colorado; Low = < 25% of range within Colorado (source: Colorado Natural Heritage Program).

Scientific Name	Common Name	Species Priority	Global & State Status Ranks	Federal Agency Status	Percent of Range in Colorado
<i>Aletes latilobus</i>	Canyonlands aletes	Tier 1	G1G2 / S1	BLM	Medium
<i>Aliciella sedifolia</i>	Stonecrop gilia	Tier 1	G1 / S1	USFS	Endemic
<i>Astragalus deterior</i>	Cliff-palace milkvetch	Tier 1	G1G2 / S1S2		Endemic
<i>Astragalus humillimus</i>	Mancos milkvetch	Tier 1	G1 / S1	LE	Low
<i>Astragalus microcymbus</i>	Skiff milkvetch	Tier 1	G1 / S1	C/BLM	Endemic
<i>Astragalus osterhoutii</i>	Kremmling milkvetch	Tier 1	G1 / S1	LE	Endemic
<i>Astragalus schmolliae</i>	Chapin Mesa milkvetch	Tier 1	G1 / S1	C	Endemic
<i>Astragalus tortipes</i>	Sleeping Ute milkvetch	Tier 1	G1 / S1	C/BLM	Endemic
<i>Boechera glareosa</i>		Tier 1	G1 / S1		Medium
<i>Corispermum navicula</i>	Boat-shaped bugseed	Tier 1	G1? / S1	BLM	Endemic
<i>Descurainia kenheillii</i>	Heil's tansy mustard	Tier 1	G1 / S1		Endemic
<i>Draba malpighiacea</i>	Whitlow-grass	Tier 1	G1? / S1?		Endemic
<i>Draba weberi</i>	Weber's draba	Tier 1	G1 / S1	USFS	Endemic
<i>Erigeron wilkenii</i>	Wilken fleabane	Tier 1	G1 / S1		Endemic
<i>Eriogonum brandegeei</i>	Brandegee wild buckwheat	Tier 1	G1G2 / S1S2	BLM/USFS	Endemic

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Scientific Name	Common Name	Species Priority	Global & State Status Ranks	Federal Agency Status	Percent of Range in Colorado
<i>Eriogonum pelinophilum</i>	Clay-loving wild buckwheat	Tier 1	G2 / S2	LE	Endemic
<i>Eutrema penlandii</i>	Penland alpine fen mustard	Tier 1	G1G2 / S1S2	LT	Endemic
<i>Gutierrezia elegans</i>	Lone Mesa snakeweed	Tier 1	G1 / S1	BLM	Endemic
<i>Hackelia gracilentia</i>	Mesa Verde stickseed	Tier 1	G1G2 / S1S2		Endemic
<i>Ipomopsis polyantha</i>	Pagosa skyrocket	Tier 1	G1 / S1	LE	Endemic
<i>Ipomopsis ramosa</i>	Coral ipomopsis	Tier 1	G1 / S1		Endemic
<i>Lepidium huberi</i>	Huber's pepperwort	Tier 1	G1G2 / S1S2		High
<i>Lygodesmia doloresensis</i>	Dolores River skeletonplant	Tier 1	G1G2 / S1S2	BLM	High
<i>Mimulus gemmiparus</i>	Budding monkey flower	Tier 1	G1 / S1	USFS	Endemic
<i>Oenothera coloradensis</i> ssp. <i>coloradensis</i>	Colorado butterfly plant	Tier 1	G3T2 / S1	LT	Medium
<i>Oreoxis humilis</i>	Pikes Peak spring parsley	Tier 1	G1 / S1	USFS	Endemic
<i>Packera mancosana</i>	Mancos shale packera	Tier 1	G1 / S1		Endemic
<i>Pediocactus knowltonii</i>	Knowlton cactus	Tier 1	G1 / SNA	LE	Historical
<i>Penstemon debilis</i>	Parachute penstemon	Tier 1	G1 / S1	LT	Endemic
<i>Penstemon gibbensii</i>	Gibben's beardtongue	Tier 1	G1G2 / S1	BLM	High
<i>Penstemon penlandii</i>	Penland penstemon	Tier 1	G1 / S1	LE	Endemic
<i>Penstemon scariosus</i> var. <i>albifluvis</i>	White River penstemon	Tier 1	G4T1 / S1	BLM	Low
<i>Phacelia formosula</i>	North Park phacelia	Tier 1	G1 / S1	LE	Endemic
<i>Phacelia gina-glenneae</i>	Troublesome phacelia	Tier 1	G1 / S1		Endemic
<i>Phacelia submutica</i>	DeBeque phacelia	Tier 1	G2 / S2	LT	Endemic
<i>Physaria congesta</i>	Dudley Bluffs bladderpod	Tier 1	G1 / S1	LT	Endemic
<i>Physaria obcordata</i>	Piceance twinpod	Tier 1	G1G2 / S1S2	LT	Endemic
<i>Physaria pulvinata</i>	Cushion bladderpod	Tier 1	G1 / S1	BLM	Endemic
<i>Physaria rollinsii</i>	Rollins twinpod	Tier 1	G1 / S1		Endemic
<i>Physaria scrotiformis</i>	West Silver bladderpod	Tier 1	G1 / S1		Endemic

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Scientific Name	Common Name	Species Priority	Global & State Status Ranks	Federal Agency Status	Percent of Range in Colorado
<i>Sclerocactus glaucus</i>	Colorado hookless cactus	Tier 1	G2G3 / S2S3	LT	Endemic
<i>Sclerocactus mesae-verdae</i>	Mesa Verde hookless cactus	Tier 1	G2 / S2	LT	Low
<i>Spiranthes diluvialis</i>	Ute ladies'-tresses	Tier 1	G2G3 / S2	LT	Medium
<i>Aletes humilis</i>	Larimer aletes	Tier 2	G2G3 / S2S3		Endemic
<i>Aletes macdougallii</i> ssp. <i>breviradiatus</i>	Mesa Verde aletes	Tier 2	G3T2T3 / S1		Medium
<i>Anticlea vaginatus</i>	Alcove death camas	Tier 2	G2 / S2		Low
<i>Asclepias uncialis</i> ssp. <i>uncialis</i>	Dwarf milkweed	Tier 2	G3G4T2T3 / S2	BLM/USFS	Very High
<i>Astragalus anisus</i>	Gunnison milkvetch	Tier 2	G2G3 / S2S3	BLM	Endemic
<i>Astragalus cronquistii</i>	Cronquist milkvetch	Tier 2	G2 / S2		High
<i>Astragalus debequaeus</i>	DeBeque milkvetch	Tier 2	G2 / S2	BLM	Endemic
<i>Astragalus equisolensis</i>	Horseshoe milkvetch	Tier 2	G5T1 / S1	BLM	Low
<i>Astragalus iodopetalus</i>	Violet milkvetch	Tier 2	G2 / S1	USFS	Medium
<i>Astragalus missouriensis</i> var. <i>humistratus</i>	Missouri milkvetch	Tier 2	G5T1 / S1	USFS	Endemic
<i>Astragalus naturitensis</i>	Naturita milkvetch	Tier 2	G2G3 / S2S3	BLM	High
<i>Astragalus piscator</i>	Fisher Towers milkvetch	Tier 2	G2G3 / S1	BLM	Low
<i>Astragalus rafaensis</i>	San Rafael milkvetch	Tier 2	G2G3 / S1	BLM	High
<i>Astragalus sparsiflorus</i>	Front Range milkvetch	Tier 2	G2 / S2		Endemic
<i>Boechera crandallii</i>	Crandall's rock-cress	Tier 2	G2 / S2	BLM	High
<i>Botrychium lineare</i>	Narrowleaf grape fern	Tier 2	G2G3 / S2S3	USFS	Medium
<i>Calochortus ciscoensis</i>	Cisco sego lily	Tier 2	G2 / S1		Low
<i>Camissonia eastwoodiae</i>	Eastwood evening primrose	Tier 2	G2 / S1	BLM	Medium
<i>Castilleja puberula</i>	Downy Indian-paintbrush	Tier 2	G2G3 / S2S3		Endemic
<i>Cirsium perplexans</i>	Adobe thistle	Tier 2	G2G3 / S2S3		Endemic
<i>Cleome multicaulis</i>	Slender spiderflower	Tier 2	G2G3 / S2S3	BLM	High

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Scientific Name	Common Name	Species Priority	Global & State Status Ranks	Federal Agency Status	Percent of Range in Colorado
<i>Delphinium ramosum</i> var. <i>alpestre</i>	Colorado larkspur	Tier 2	G4T2 / S2		High
<i>Delphinium robustum</i>	Wahatoya Creek larkspur	Tier 2	G2? / S2?		Medium
<i>Draba exunguiculata</i>	Clawless draba	Tier 2	G2 / S2	USFS	Endemic
<i>Draba graminea</i>	San Juan whitlow-grass	Tier 2	G2 / S2		Endemic
<i>Draba grayana</i>	Gray's Peak whitlow-grass	Tier 2	G2 / S2	USFS	Endemic
<i>Draba smithii</i>	Smith whitlow-grass	Tier 2	G2 / S2	USFS	Endemic
<i>Erigeron kachinensis</i>	Kachina daisy	Tier 2	G2 / S1	BLM	Low
<i>Eriogonum clavellatum</i>	Comb Wash buckwheat	Tier 2	G2 / S1	BLM	Medium
<i>Eriogonum coloradense</i>	Colorado wild buckwheat	Tier 2	G2 / S2	BLM	Endemic
<i>Frasera coloradensis</i>	Colorado green gentian	Tier 2	G2G3 / S2S3		Endemic
<i>Herrickia horrida</i>	Canadian River spiny aster	Tier 2	G2? / S1		Medium
<i>Ipomopsis aggregata</i> ssp. <i>weberi</i>	Rabbit Ears gilia	Tier 2	G5T2 / S2	USFS	Very High
<i>Ipomopsis globularis</i>	Globe gilia	Tier 2	G2 / S2	USFS	Endemic
<i>Lepidium crenatum</i>	Alkaline pepperwort	Tier 2	G2 / S2		Medium
<i>Limnorchis zothecina</i>	Alcove bog orchid	Tier 2	G2 / S1		Low
<i>Lomatium concinnum</i>	Colorado desert-parsley	Tier 2	G2G3 / S2S3	BLM	Endemic
<i>Lupinus crassus</i>	Payson lupine	Tier 2	G2 / S2	BLM	Endemic
<i>Mentzelia paradoxensis</i>	Paradox stickleaf	Tier 2	G2? / S2?		Endemic
<i>Mentzelia rhizomata</i>	Roan Cliffs blazing star	Tier 2	G2 / S2	BLM	Endemic
<i>Mertensia humilis</i>	Rocky Mountain bluebells	Tier 2	G2 / S1		Medium
<i>Nuttallia chrysantha</i>	Golden blazing star	Tier 2	G2 / S2	BLM	Endemic
<i>Nuttallia densa</i>	Arkansas Canyon stickleaf	Tier 2	G2 / S2	BLM	Endemic
<i>Oenothera acutissima</i>	Narrow-leaf evening primrose	Tier 2	G2 / S2	BLM	Medium
<i>Oonopsis foliosa</i> var. <i>monocephala</i>	Rayless goldenweed	Tier 2	G3G4T2 / S2		Endemic

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Scientific Name	Common Name	Species Priority	Global & State Status Ranks	Federal Agency Status	Percent of Range in Colorado
<i>Oonopsis puebloensis</i>	Pueblo goldenweed	Tier 2	G2 / S2		Endemic
<i>Oreocarya osterhoutii</i>	Osterhout cat's-eye	Tier 2	G2G3 / S2	BLM	Low
<i>Oreocarya revealii</i>	Gypsum Valley cat's- eye	Tier 2	G2 / S2	BLM	Endemic
<i>Oxybaphus rotundifolius</i>	Round-leaf four o'clock	Tier 2	G2 / S2		Endemic
<i>Oxytropis besseyi</i> var. <i>obnapiformis</i>	Bessey locoweed	Tier 2	G5T2 / S2		Very High
<i>Penstemon acaulis</i> var. <i>yampaensis</i>	Yampa beardtongue	Tier 2	G3T2 / S2		High
<i>Penstemon degeneri</i>	Degener beardtongue	Tier 2	G2 / S2	BLM/USFS	Endemic
<i>Penstemon fremontii</i> var. <i>glabrescens</i>	Fremont's beardtongue	Tier 2	G3G4T2 / S2		Endemic
<i>Penstemon grahamii</i>	Graham beardtongue	Tier 2	G2 / S1	BLM	Low
<i>Penstemon mensarum</i>	Grand Mesa penstemon	Tier 2	G2 / S2		Endemic
<i>Penstemon scariosus</i> var. <i>cyanomontanus</i>	Plateau penstemon	Tier 2	G4T2 / S2		High
<i>Physaria alpina</i>	Avery Peak twinpod	Tier 2	G2 / S2		Endemic
<i>Physaria bellii</i>	Bell's twinpod	Tier 2	G2G3 / S2S3		Endemic
<i>Physaria parviflora</i>	Piceance bladderpod	Tier 2	G2 / S2	BLM	Endemic
<i>Physaria pruinosa</i>	Pagosa bladderpod	Tier 2	G2 / S2	BLM/USFS	Endemic
<i>Physaria vicina</i>	Good-neighbor bladderpod	Tier 2	G2 / S2	BLM	Endemic
<i>Potentilla rupincola</i>	Rocky Mountain cinquefoil	Tier 2	G2 / S2	USFS	Endemic
<i>Ptilagrostis porteri</i>	Porter feathergrass	Tier 2	G2 / S2	USFS	Endemic
<i>Puccinellia parishii</i>	Parish's alkali grass	Tier 2	G2G3 / S1		Low
<i>Salix arizonica</i>	Arizona willow	Tier 2	G2G3 / S1	USFS	Low
<i>Saussurea weberi</i>	Weber saussurea	Tier 2	G2G3 / S2		High
<i>Telesonix jamesii</i>	James telesonix	Tier 2	G2 / S2		Very High
<i>Thalictrum heliophilum</i>	Sun-loving meadow rue	Tier 2	G2 / S2	BLM/USFS	Endemic
<i>Thelypodopsis juniperorum</i>	Juniper tumble mustard	Tier 2	G2 / S2		Endemic

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Scientific Name	Common Name	Species Priority	Global & State Status Ranks	Federal Agency Status	Percent of Range in Colorado
<i>Thelypodium paniculatum</i>	Northwestern thelypody	Tier 2	G2 / SH		Low
<i>Townsendia fendleri</i>	Fendler's townsend-daisy	Tier 2	G2 / S2		High
<i>Townsendia glabella</i>	Gray's townsend-daisy	Tier 2	G2 / S2		Endemic
<i>Townsendia rothrockii</i>	Rothrock townsend-daisy	Tier 2	G2G3 / S2S3		Endemic
<i>Trifolium dasyphyllum</i> ssp. <i>anemophilum</i>	Whip-root clover	Tier 2	G5T2? / S1		Low

Part 2: KEY HABITATS

Colorado's imperiled plants occur within eight major habitat types: *alpine*, *barrens*, *cliffs and canyons*, *grasslands*, *forests*, *pinon-juniper woodlands*, *shrublands*, and *wetlands* (CNHP 2014; CNHP and TNC 2011; Colorado Native Plant Society 1997).

Colorado's barrens and shrublands are especially rich habitats for imperiled plant species, followed by alpine, pinon-juniper woodlands, and cliff and canyon habitats (CNHP 2014, CNHP and TNC 2011). Shrublands are Colorado's most important habitat for rare plants (supporting 24% of the imperiled species), occupying 19% of the state's acreage. Barrens are the second most important habitat for PGCN, occupying less than 1% of Colorado, but supporting 20% of our rarest plants. Alpine, pinon-juniper woodlands, and cliff and canyon habitats combined provide habitat for nearly 40% of the state's rare plant species (Figures 2 and 3). Mapping of habitat types is from SWReGAP (Prior-Magee et al. 2007; USGS 2004).

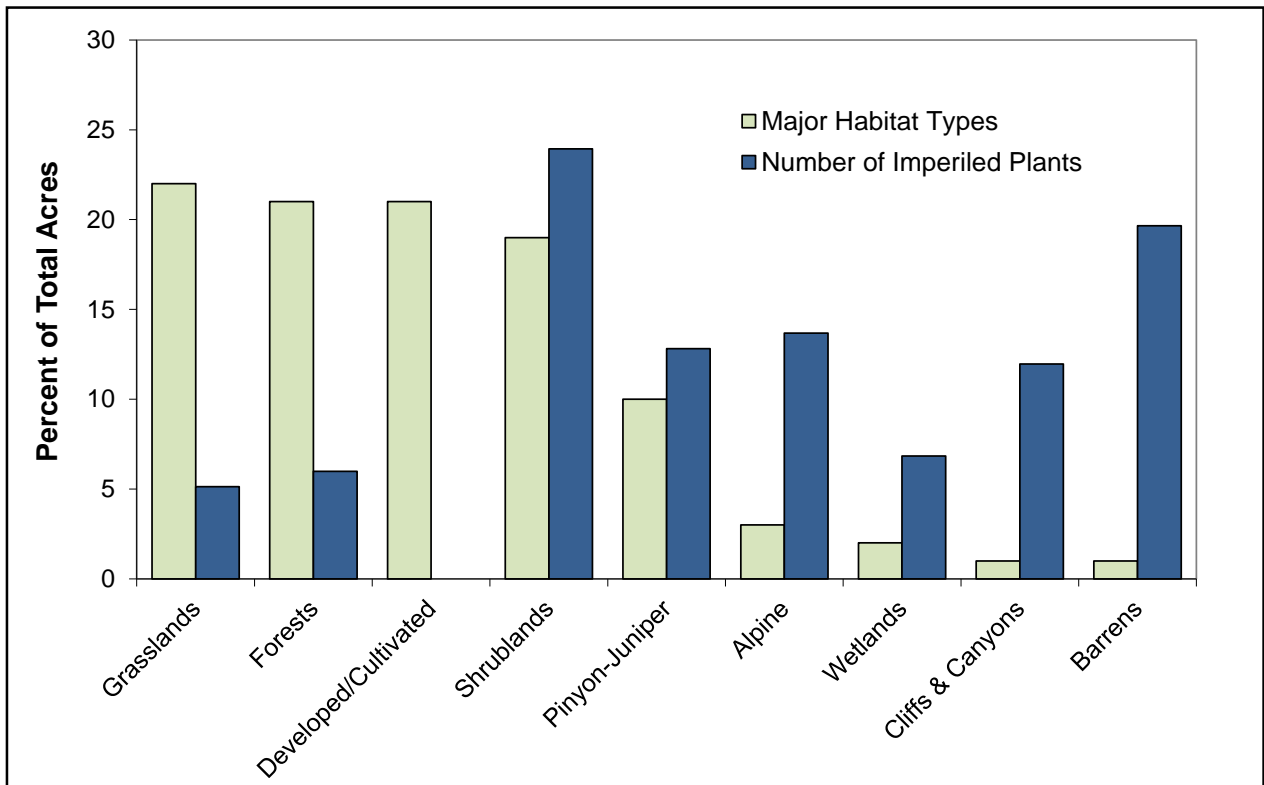


Figure 2. Key habitats as percentage of Colorado and the number of PGCN within each habitat type.

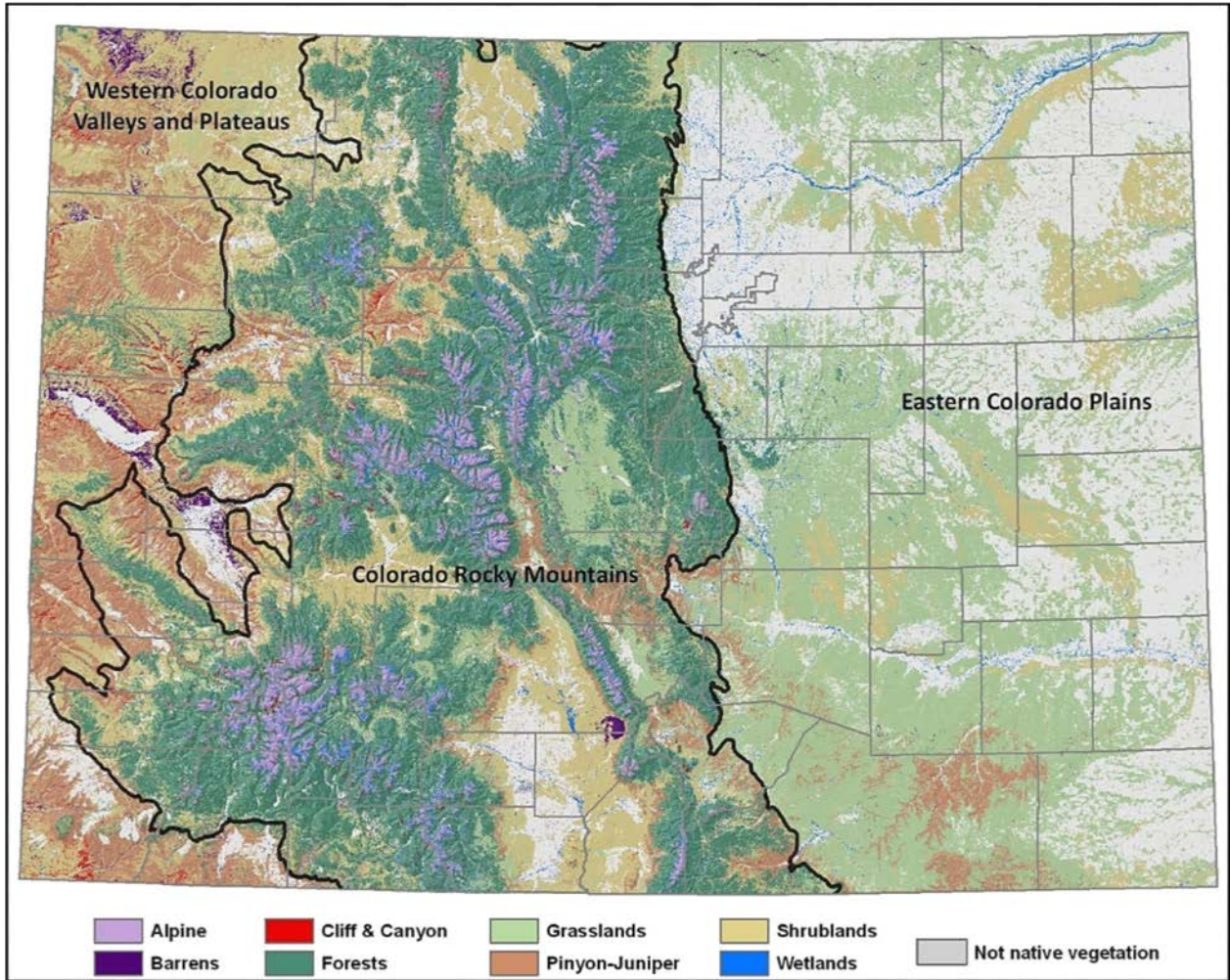


Figure 3. Distribution of major rare plant habitat types in Colorado.

Relationship between Key Habitats for Wildlife and Plants

The way that rare plant habitat types have been categorized (Neely et al. 2009, CNHP and TNC 2011) is slightly different from the habitat categorization used for animals in Colorado's SWAP. Categories that are common to both plants and animals are grasslands, forests, shrublands, pinyon-juniper woodlands, wetlands, alpine, and cliff and canyon habitats. However, the SWAP did not specifically recognize the barrens habitat type for wildlife that is, in fact, one of the highest priority habitat type for plants.

Therefore, this habitat type has been added to Colorado's SWAP to reflect the importance of the barrens habitat for PGCN. Colorado's SWAP now addresses the condition of all key habitats pertinent to PGCN, including barrens. For a description of each habitat type see Chapter 3 in the full 2015 SWAP document.

In the SWAP, grassland, forest, shrubland, and wetland categories all had some habitat types that were considered high priority. For plants, all habitat types discussed in this Addendum are considered priority habitats, since they all support globally imperiled species that are at risk of extinction. However, based on the concentration of rare plants in each habitat type relative to the percentage of Colorado covered by that habitat type (Figure 2), five habitat types stand out as being critically important to conservation of imperiled plant species: shrublands, barrens, alpine, cliffs and canyons, and pinyon-juniper woodlands (Table 2, Figure 3). This Addendum does not change the conservation priorities for habitats presented in the SWAP; rather, it expands the priority list to include the barrens habitat specific to rare plant conservation. Details on species supported, key threats, and prioritized conservation actions for PGCN habitats can be found in the full SWAP document, Chapter 6: Threats and Actions for Habitats.

Table 2. Relative priorities for key rare plant habitats based on the concentration of rare plants in each habitat type relative to the percentage of Colorado covered by that habitat type.

Habitat Priority	Habitat Category	Habitat Type
Very High	Shrublands	Desert Shrub
		Greasewood
		Oak & Mixed Mountain Shrub
		Sagebrush
		Saltbrush
		Sandsage
		Upland Shrub
	Barrens	Barrens
High	Alpine	Alpine
	Cliff and Canyon	Cliff and Canyon
	Pinyon-Juniper	Pinyon-Juniper
Moderate	Wetlands	Grass/Forb Dominated Wetlands
		Playas
		Riparian Woodlands & Shrublands
		Seeps and Springs
		Shrub-dominated Wetlands
	Forests	Aspen Forest
		Douglas Fir
		Limber/Bristlecone Pine
		Lodgepole
		Mixed Conifer
		Ponderosa Pine
	Spruce-Fir	
	Grasslands	Foothill/Mountain Grassland
Mixed/Tallgrass prairie		
Shortgrass prairie		

Part 3: PROBLEMS AFFECTING THE SPECIES

Colorado's human population is rapidly expanding and land uses, such as energy and residential development, are increasing impacts to Colorado's native plants and their habitats. Colorado continues to be one of the fastest growing states in the country. The population is expected to grow from approximately 5.5 million in 2015 to approximately 7.8 million by 2040 (Colorado Department of Local Affairs 2015). The statewide development footprint increased from 1.3 million acres in 1970 to 2.5 million acres in 2000 and is expected to expand to more than 3.5 million acres by 2030. The state is losing its largest privately owned agricultural and natural lands many times faster than any other state in the nation (Colorado Conservation Trust 2007).

Colorado's irreplaceable native plants, plant communities, and ecosystems are thus increasingly being threatened. Most of Colorado's imperiled plants are naturally rare. They are rare because they are restricted to very specific, narrowly distributed habitats, rather than as a result of human actions, per se. However, because these species occupy such small areas, planning is necessary to avoid placing these species at further risk from human activities. Degradation, fragmentation, and loss of habitat are major reasons plant species and their habitats are imperiled or vulnerable in Colorado. The primary contributors to habitat degradation for imperiled plants are **energy development**, **motorized recreation**, **residential development**, and **road construction and maintenance** (CNHP and TNC 2011). Other risk factors include altered hydrologic regime, invasive species, agricultural development, loss of pollinators, incompatible grazing/trampling, and plant collecting (CNHP and TNC 2011). Additionally, there is strong scientific consensus that human-induced climate change is affecting species and ecological systems, and this is likely to exacerbate the effects of other human activities on plants (Enquist and Gori 2008).

One of the biggest issues is a **lack of awareness** and information regarding the presence, distribution, and precarious status of Colorado's native and imperiled plant species. Many rare plants inhabit small areas, have specialized needs, and have unique habitat requirements that are often missed by other approaches to conservation (e.g., those focused primarily on ecosystems or wildlife). Additionally, a lack of funding to support rare plant research and conservation activities has been a chronic problem.

The following issues are statewide in scope, and apply to many PGCN. Part 5; Table 3 presents general and specific threats on a species-by-species basis.

Energy Development

The region's recent energy boom has rapidly transformed areas of Colorado, both economically and environmentally. According to Colorado Conservation Trust (2007), applications for oil and gas drilling permits increased by almost 500% from 1999 (1,010) to 2006 (5,904). Also, over 6,000 drilling permit applications were approved in 2007 — more than two-and-a-half times the 2,378 permits approved

during Colorado's last energy development boom in 1981. The number of active oil and gas well in Colorado has almost doubled from 22,228 in 2000 to 43,354 in 2010 (Sumi 2012). The habitat that supports many rare plants throughout the state is underlain by rich deposits of oil and natural gas. Over 25% of PGCN are found in such habitats. Oil and gas development activities and associated infrastructure can cause population fragmentation, habitat destruction and degradation, introduction of non-native plants, and alteration of surface hydrology. Oil and gas development often creates a high density of roads; these roads can provide easy access to new areas for off-road vehicle use (Center for Native Ecosystems et al. 2005). Further, the habitat for rare plant species restricted to the Green River Formation in the Piceance Basin contains high grade oil shale deposits. The Parachute Creek Member of the Green River Formation is reported to have the best deposits of oil shale known in the world and is considered to be a major potential source of oil in the United States. However, millions of tons of shale must be mined each year to make the process economically feasible. The impacts of oil shale mining and processing can increase erosion due to vegetation removal, increase air pollution, fragment and/or eliminate some plant populations, and degrade remaining habitat, e.g., by spread of introduced invasive plant species (Center for Native Ecosystems et al. 2005).

Motorized Recreational Activities

Motorized recreation (including off highway, off road, all terrain, and four-wheel drive vehicles, motorcycles, and snowmobiles) is rapidly increasing in many areas where Colorado's rare plants grow. Nearly 30% of PGCN are directly threatened by motorized recreation, and it is often difficult to enforce regulations or close access to protect plant habitat. Roads and trails created by off-road vehicles impact plants by altering habitat, killing plants, increasing erosion, and creating dispersal corridors for invasive plant species.

Residential Development

Twenty-one (18%) of PGCN are currently threatened by urban, suburban, and ex-urban development. Accelerating residential and urban development, along with associated infrastructure such as roads and utilities, is consuming and fragmenting important habitat for native plants and plant communities. Exurban development (low-density rural development), the fastest growing land use in the United States, has been found to reduce many native species near homes and increase exotic species, with effects manifested over decades (Hansen et al. 2005). In addition to local effects, exurban development may alter ecological processes and biodiversity on adjacent and distant public lands. Underlying mechanisms involve alteration of habitat, ecological processes, biotic interactions, and increased human disturbance (Hansen et al. 2005).

Road Construction and Maintenance

Roads can have a serious impact upon the natural integrity and habitat effectiveness of rare plant sites. Along with extirpating populations and destroying habitat, roads contribute to fragmentation that may interfere with natural processes such as pollination and seed dispersal. Further, roads can act as barriers to insect pollinators for some plants. Other impacts from road construction and maintenance (e.g., mowing and herbicide application) include erosion and sedimentation, as well as introduction of invasive species. Thirty-nine (33%) of PGCN are threatened by fragmentation from road construction and/or ROW maintenance.

Climate Change

Climate change is already having serious impacts across the globe. In the 20th century, global temperatures increased by 0.7 °C (1.3 °F) and Northern Hemisphere snow cover declined by 7% (Intergovernmental Panel on Climate Change 2007). The change in climate is driving plants out of their current geographic ranges and will likely result in regional extirpation and even extinction for some plant species (Schneider et al. 2007). Warmer temperatures and changing rainfall have shifted vegetation in several ecosystems up mountain slopes and towards polar regions. Alteration of seasons has changed the timing of life-cycle events of plants and animals, potentially resulting in an asynchrony between plants, environmental cues, and interacting organisms such as pollinators (Joyce 2008). Colorado is predicted to become 2.5 to 5°F hotter with spring run-off occurring 1-3 week's earlier (Lukas et al. 2014). Further, most models predict Colorado will see an increase in heat waves, drought and wildfire frequency and severity by mid-century. These potential impacts will interact with the other stresses to rare plants, e.g., loss or fragmentation of habitat from development, mining, and the introduction of invasive species. The full impacts of climate change on imperiled species are likely to significantly reduce habitat, which is particularly problematic for rare plants that demand very specific growing conditions (Loarie et al. 2008).

To get a better sense of the relative vulnerability of the PGCN to climate change, the Colorado Natural Heritage Program (CNHP) conducted a rapid, first-iteration assessment using NatureServe's Climate Change Vulnerability Index (CCVI) (Appendix B). They used available data sources, including CNHP's databases and the U.S. Forest Service species assessments. However, there are significant data gaps for most of the PGCN. Therefore, many assumptions were made based on field observations, expert judgment, information on related species, and general habitat-level information.

Not surprisingly, the majority of the 117 PGCN scored Extremely Vulnerable or Highly Vulnerable (Appendix B, Table 3). Exceptions were *Cirsium perplexans* and *Ptilagrostis porteri*, which scored Moderately Vulnerable, and *Ipomopsis aggregata* ssp. *weberi*, which scored Presumed Stable. There was insufficient information to complete the Index for three species *Delphinium robustum*, *Pediocactus*

knowltonii and *Thelypodium paniculatum*. Overall, the most significant factors contributing to PGCN vulnerability to climate change are:

- restricted range,
- inability to disperse long distances,
- restricted habitats and natural barriers that prevent range/distribution shifting, and
- sensitivity to moisture regimes (reduced future moisture availability, physiological hydrological niche (micro-habitats), and historic hydrological niche (surrogate for species' tolerance for fluctuations in moisture availability)).

Over half (58%) of Colorado's PGCN have their entire range within the state, which is projected to experience temperature increases of approximately 5 – 5.5 degrees Fahrenheit (www.climatewizard.org). For most PGCN (82%), natural barriers such as major rivers, mountain ranges, restriction of required substrates, and/or other environmental conditions exist that may inhibit or prevent range/distribution shifts in response to climate change. This is especially true for the species that inhabit alpine, barrens, and cliff/canyon habitats.

With a few exceptions, anthropogenic barriers are generally not as significant a factor in climate change vulnerability. However, the anthropogenic barrier factor was one of the factors with more significant uncertainty in the scoring, along with moisture regimes and climate change mitigation land uses. Anthropogenic barrier scores were estimated using coarse scale data in GIS. The degree to which coarse scale assessments are accurate at rare plant occurrence scales is unknown.

Among climate change projection models, there is much less agreement on precipitation projections for Colorado than there is on temperature. Scoring factors related to hydrology are significant for some species, particularly those that inhabit riparian or wetland habitats, and those that seek out cool/moist micro-climates. Therefore, this factor should be re-assessed as climate change models improve.

Roughly half (42%) of the PGCN were rated vulnerable to potential future threats from land uses designed to mitigate climate change (e.g., renewable energy development such as wind, solar, and natural gas exploration). However, there are many influences over land use – economic, political, and social –how actual land use plays out over future years is highly uncertain.

The most significant data gaps are species specific information on pollinators and mutualisms such as mycorrhizal relationships. This lack of knowledge has also been identified in the Threats and Conservation Actions component of this document. A significant issue that was beyond the scope of this project is estimating how and where rare plant habitats and distributions may shift as a result of changing climate. This is a crucial next step in refining conservation and adaptation strategies for Colorado's PGCN.

Other Factors

Many rare plants are restricted to unusual substrates and comprise very small populations, thereby rendering them subject to random catastrophic events such as landslides, flooding or insect infestations. Other factors that impact Colorado's rare plants include: 1) widespread lack of awareness regarding their existence and precarious status; 2) inadequate funding for conservation and research; 3) inadequate legal protection for plants; and 4) over-collection for horticultural purposes (e.g., penstemons, cacti, orchids) or medicinal uses (e.g., arnica).

Part 4: PRIORITIES FOR CONSERVATION ACTION

The following statewide conservation objectives, adapted from the RPCI Rare Plant Conservation Strategy, are necessary to meet the conservation needs of Colorado's PGCN. These objectives represent the most urgent and critical actions needed to effectively conserve Colorado's imperiled plant species. These objectives will guide conservation activities and catalyze collaborative conservation action over the next decade.

The following Objectives and Conservation Actions are statewide in scope, and are applicable to all PGCN. Part 5, Table 3 presents specific, prioritized conservation actions on a species-by-species basis.

Statewide Conservation Objectives

The six statewide conservation objectives are:

1. ***Secure on-the-ground, site-specific habitat protection and/or management*** to achieve specific goals for all of Colorado's imperiled plants on public and private lands. Focus these activities in places that are likely to remain stable under predicted climate change scenarios, and on areas needed to maintain habitat connectivity (e.g., to facilitate climate-related distributional shifts).
2. ***Minimize threats*** from specific land uses that impact many of Colorado's imperiled plants statewide, and ***develop climate change adaptation strategies*** for vulnerable species.
3. ***Improve scientific understanding*** of the distribution, natural history, response to climate change, and status of Colorado's most imperiled plants through inventory, research, and monitoring.
4. ***Develop and implement a state program and policies*** to enhance the conservation of Colorado's most imperiled plants in cooperation with public land managers, private landowners, and other interested stakeholders.

5. **Facilitate the stewardship** of Colorado's most imperiled plants through education, outreach, and coordination.
6. **Adopt measures for the ex situ (off site) conservation** of Colorado's most imperiled plants in case native populations are extirpated due to stochastic events, anthropogenic impacts, and/or climate change.

Recommended Conservation Actions for Short-term (1-5 years)

The recommended actions below are reflect both the priorities from the RPCI Strategy and the species specific actions listed as high priority in Part 5, Table 3.

1. Select targeted PGCN for site-specific conservation action each year (e.g., select "poorly conserved" species from Colorado's Biodiversity Scorecard).
2. Prioritize the 26 Important Plant Areas ranked (B1) and without Conservation Action Plans, for action in 2015-2020 (Appendix C).
 - a. Develop and implement conservation action plans with working groups consisting of local experts, land trusts, and land managers. Identify appropriate actions for each area.
 - b. Work with land trusts and willing landowners to place conservation easements on private lands within the B1 Important Plant Areas (and selected B2s).
 - c. Work with the Colorado Natural Areas Program to protect the B1 Important Plant Areas as Colorado Natural Areas. Develop multi-species proposals to fund habitat protection of imperiled plant species across Colorado.
3. Work with public agencies to promote consideration of PGCN in land use planning, enforce existing grazing, travel and surface occupancy regulations, and establish and/or expand legal designation to protect habitat
4. Work with public agencies to collect/share best available data and to develop and implement best management practices for energy development, transportation, recreation, urban/exurban development, grazing, and weed control, and to pursue special agency designations for PGCNs as needed.
5. Work with public agencies and to educate development industries about avoiding and/or mitigating impacts to PGCN, and Publish educational material/sponsor educational programs to raise public awareness of PGCN.

6. Develop a plant policy for the Colorado Department of Natural Resources, General Assembly joint resolution, and Governor's executive order.
7. Develop a bill for a state plant statute that establishes a legally-recognized list of PGCN, acknowledges Colorado's interest in protecting them, and provides a variety of resources for their conservation.
8. Integrate the PGCN into other statewide conservation planning and protection efforts in addition to the SWAP. Examples include the Statewide Forest Assessment, Colorado Conservation Partnership, Colorado Conservation Summit, federal management plan revisions, and local planning efforts.
9. Improve scientific understanding of the distribution, natural history, response to management, disturbance, and climate change, and address the current status of PGCN through inventory, research and monitoring.
10. Adopt measures for ex situ (off site) conservation in case native populations are extirpated. This is recommended as a high priority action for all Tier 1 and Tier 2 PGCN.
11. Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)
12. Conduct taxonomic and/or genetic research. Four Tier 1 and four Tier 2 species are in need of taxonomic research.

Long-term Recommendations (5-10 years)

1. Update the *Biodiversity Scorecard* every five years and address climate change and other emerging impacts in future iterations.
2. Update the *Colorado Rare Plant SWAP component of Colorado's SWAP* every ten years, starting in 2025, and include consideration of other plant species groups such as vulnerable vascular plant species (ranked G3 by CNHP and NatureServe) and non-vascular plants (lichens, mosses, and liverworts).
3. Update the *Colorado Rare Plant Conservation Strategy* every ten years, starting in 2019, and include consideration of other plant species groups such as vulnerable vascular plant species (ranked G3 by CNHP and NatureServe) and non-vascular plants (lichens, mosses, and liverworts).
3. Develop conservation action plans for all high priority B2 Important Plant Areas, working with local experts, land trusts, and land managers.
4. Assess status of threats, protection/conservation, and viability of Colorado's PGCN every five years.

Important Plant Areas

Over 290 Important Plant Areas (IPAs) have been identified by the Colorado Natural Heritage Program and recognized by RPCI. IPAs are based on CNHP's Potential Conservation Areas, and include the highest quality locations for PGCN. They are ranked by CNHP on a scale as having either Outstanding Biodiversity Significance (B1) or Very High Significance (B2). Figure 4 depicts the location of all the IPAs within Colorado. IPAs represent our best estimate of the areas needed to support the continued existence of Colorado's most imperiled plant species in places where they currently occur. Potential distribution shifts in response to climate change are not incorporated in this iteration; however, modeling potential habitat/range shifts in response to projected climate changes is a high priority conservation action for all PGCN. Although IPAs do not carry any regulatory authority, they can provide guidance on opportunities for conservation, and highlight places where public land managers and private landowners can help conserve plant species and habitats. Figure 5 shows the relationship of the IPAs to Colorado Natural Areas which are one of the ways PGCN are provided with some protection on both public and private lands. There are 42 Designated Natural Areas that recognize and conserve portions of 39 IPAs. In addition, portions of 33 IPAs are protected within Bureau of Land Management Areas of Critical Environmental Concern (ACEC), Wilderness Study Areas (WSA) or U.S. Forest Service Research Natural Areas. A complete list of IPAs can be found in Appendix C, and of Designated Natural Areas within IPAs in Appendix D.

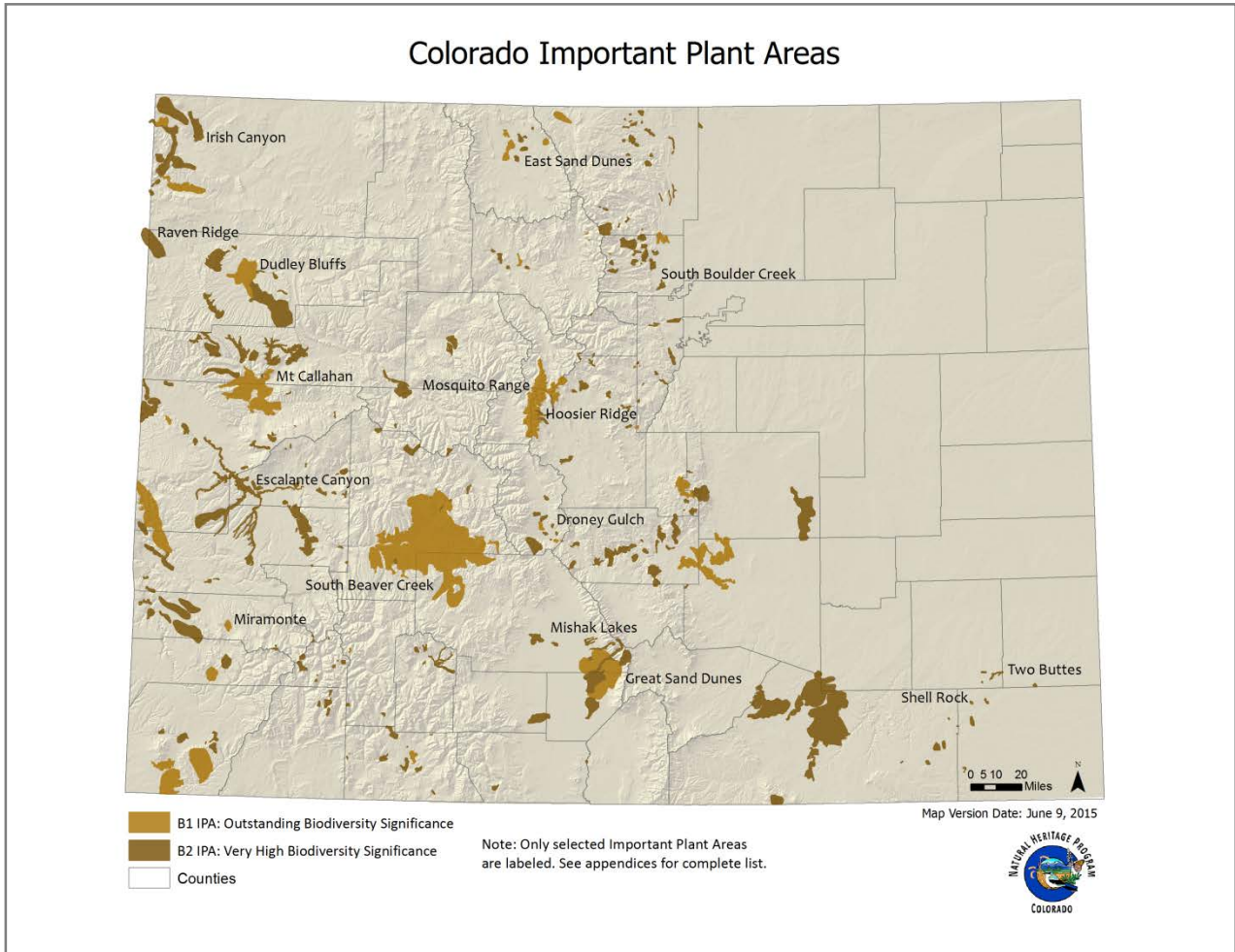


Figure 4. Map of Important Plant Areas (IPAs) in Colorado.

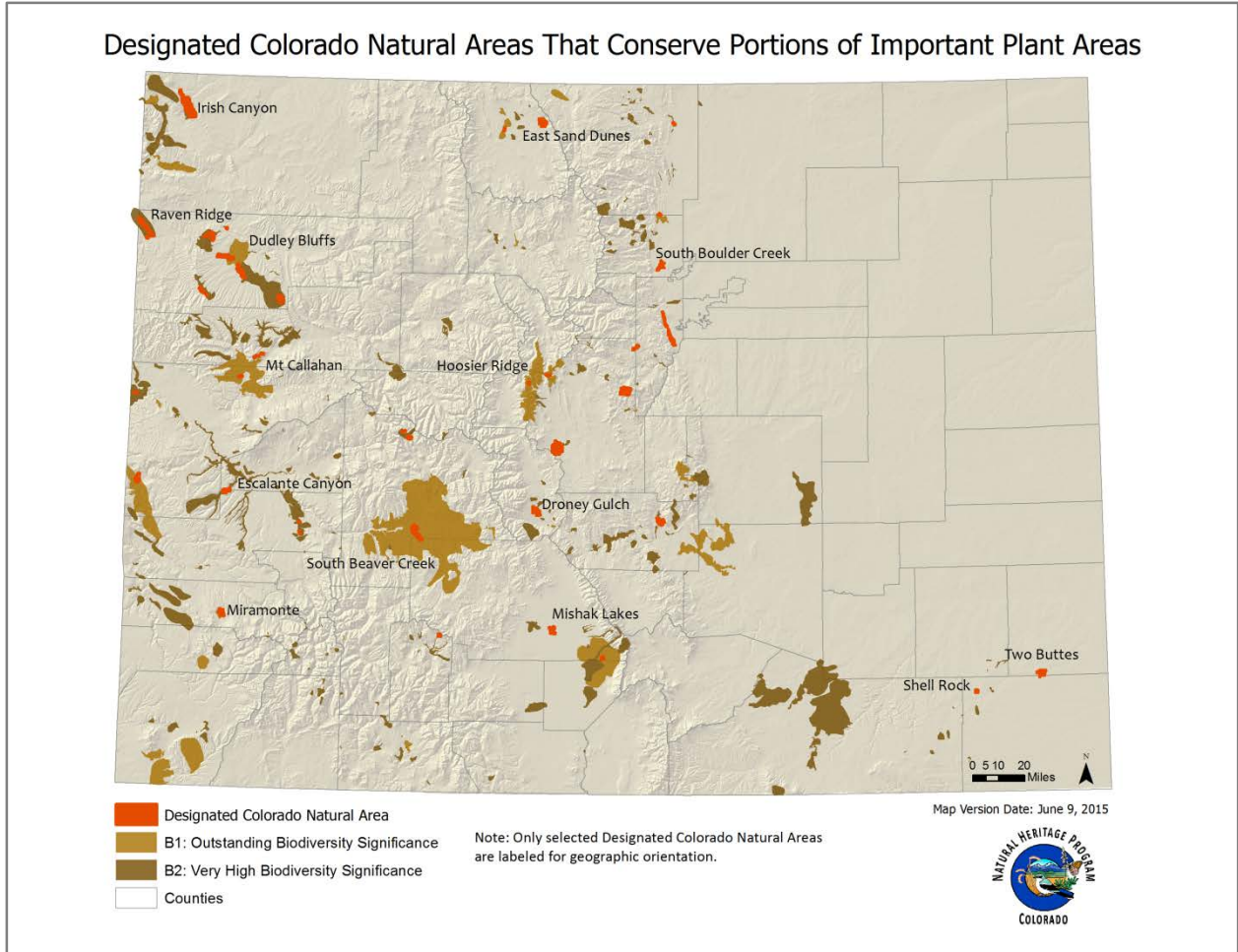


Figure 5. Map of Designated Colorado Natural Areas that conserve portions of Important Plant Areas.

Priority Research and Survey Efforts Needed

Research

Very little is known about the life history and reproductive biology of most Colorado's PGCN. Fifty-six of the PGCN list lack of knowledge on reproductive and/or pollination biology, and specific habitat parameters as a threat. Response to change, disturbance, and other threats are poorly understood for nearly 40 of the PGCN. Additionally, eleven species need taxonomic work, including *Dolores* River skeletonplant (*Lygodesmia doloresensis*) and the Colorado and Wahatoya Creek larkspurs (*Delphinium ramosum* var. *alpestre* and *D. robustum*) among others (Part 5, Table 3). Increased collaboration with academic institutions will help address the key research needs of Colorado's imperiled plants.

Recommended research and research-related activities include:

- Prioritize research needs for Colorado's PGCN annually (for example, during Annual Colorado Rare Plant Technical Committee Symposia, Biodiversity Scorecard updates, etc.) and share priorities with the academic community and other partners.
- Support and conduct research that seeks to better understand how human activities, such as dust from energy development, ORV use, or herbicide application may impact PGCN, and inform mitigation of the impacts of these activities (e.g., through use of Best Management Practices, Integrated Weed Management Plans, reintroductions, etc.).
- Conduct systematic and genetic research on those PGCN for which there are taxonomic questions. Conduct analyses for plant chemicals that could be effective in medicines.
- Support and conduct species-specific research to answer basic questions about the natural history of PGCN, including response to climate change. Priorities include reproductive biology (e.g., pollination, breeding system, and seed dispersal mechanisms), life history (e.g., germination requirements and survival to reproduction), and ecology (e.g., edaphic or soil requirements and mycorrhizal relationships), as well as other important ecological processes needed for their survival (e.g., fire or other disturbance). Priority research needs for climate change include response to, and tolerable thresholds for, increasing temperatures, and both increasing and decreasing moisture availability.
- Model how species' habitat and distributions may shift in response to climate change.

Survey

A number of PGCN are in particular need of focused field surveys to inform understanding of distribution, level of rarity and imperilment, and current status. There are 87 PGCN for which the complete distribution in Colorado is yet not fully known, and 65 PGCN for which a majority of the locations are considered historical (e.g. not visited in 20 or more years.). PGCN with primarily historical observations include, but are not limited to Cronquist milkvetch (*Astragalus cronquistii*), Mancos milkvetch (*Astragalus humillimus*), and Comb Wash buckwheat (*Erigonum clavellatum*). Recently described species such as Coral ipomopsis (*Ipomopsis ramosa*) and West Silver bladderpod (*Physaria scrotiformis*) are some of the many PGCN for which the complete distribution in Colorado is unknown.

Recommended surveys and survey-related actions include the following. See Part 6 for monitoring recommendations.

- Prioritize survey needs for PGCN annually (for example, during Annual Colorado Rare Plant Technical Committee Symposia, Biodiversity Scorecard updates, etc.).

Colorado's 2015 State Wildlife Action Plan

- Conduct targeted surveys of Colorado's PGCN to fill data gaps and increase knowledge about geographic range, distribution, population size, condition, threats, and status. Document the occurrence and distribution of PGCN with CNHP occurrence records, voucher specimens, and photographs.
- Evaluate recommended conservation actions for PGCN (species and occurrences) through targeted site visits and existing database information.
- Periodically update Important Plant Areas for all PGCN to guide conservation actions, and assess status of IPAs in terms of climate change. Conduct field visits of existing and potential additional IPAs as identified by the CNHP.
- Secure funding to help update and maintain CNHP's database to enhance the ability to keep the Colorado Rare Plant Conservation Strategy and any rare plant component of Colorado's SWAP current.
- Acquire fine-scale data necessary for high-precision modeling of the rarest PGCN and conduct modeling to inform targeted surveys.

Part 5: PRIORITIES, THREATS, AND CONSERVATION ACTIONS FOR PGCN

The following tables contain detailed conservation priorities, threats, and conservation actions for PGCN species (Table 3). Part 1 of this document describes the general process used for generating these tables, and is repeated here for reference. Information on distribution, population status, and trends for all PGCN was compiled from a variety of sources. Data sources included:

- 1) the Colorado Natural Heritage Program's conservation databases (Element Occurrence records, Element Tracking records, Element Rank Reports, and characterization abstracts);
- 2) Colorado's Biodiversity Scorecard (CNHP and TNC 2011);
- 3) U.S. Forest Service species assessments (<http://www.fs.fed.us/r2/projects/scp/assessments/index.shtml>);
- 4) the Colorado Rare Plant Field Guide (<http://www.cnhp.colostate.edu/>);
- 5) published and unpublished literature, and herbarium collections;
- 6) expert opinion of Colorado's scientific community, via the RPCI and the NS network of Heritage Programs.

These data were compiled in an Access database to support data organization and reporting for this Addendum, in the same format as the wildlife SWAP, as well as to allow for ease in future updating as new information becomes available. These data are housed at the Colorado Natural Heritage Program (www.cnhp.colostate.edu). Distribution information is based primarily on CNHP's element occurrence database (CNHP 2015). Population status information is drawn from the species Biodiversity Score in Colorado's Biodiversity Scorecard, which reflects the size, quality and landscape integrity of species occurrences in Colorado. Scores are High, Medium and Low. Population trend information, when available, is from CNHP's Element Rank Report database. Habitat is derived from various sources including SW REGap and refined by expert opinion.

Detailed conservation priorities, threats, and conservation actions for habitats can be found in the full SWAP document, Chapter 6: Threats and Actions for Habitats.

Table 3. Plant Species of Greatest Conservation Need – Priorities, Threats, and Conservation Actions. Sorted by priority (Tier 1 and 2), then by Taxonomic Group, then by Scientific Name.

Tier 1	Plants
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Canyonlands aletes	Population Status	Population Trend	Distribution	Type	Habitat	Primary	
	Medium	D	Unknown	Colorado Plateau	P	Cliffs and Canyons Saltbush	<input checked="" type="checkbox"/> <input type="checkbox"/>

Aletes latilobus

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
06.1 Recreational Activities	Non-motorized recreation	2.1 Site/Area Management	Manage public use to minimize habitat disturbance	M
06.1 Recreational Activities	Non-motorized recreation; climbing.	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	L
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Implement demographic monitoring	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Stonecrop gilia		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Low	D	Stable	D	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>
<i>Aliciella sedifolia</i>									
Tier 1 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action	Priority	
02.3 Livestock Farming & Ranching	Degradation of alpine habitats from sheep grazing					2.1 Site/Area Management	Implement compatible grazing management	H	
06.1 Recreational Activities	Motorized recreation					1.2 Resource & Habitat Protection	Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H	
06.1 Recreational Activities	Non motorized recreation					2.1 Site/Area Management	Manage public use to be compatible with biodiversity	H	
06.1 Recreational Activities	Non-motorized recreation					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.6 Response to change, disturbance, & other threats poorly understood	Response to management/disturbance poorly understood					8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H	
14.1 Scarcity	Globally rare and/or small population size					8.0 Research & Monitoring	Research critical life history/habitat components	H	
06.1 Recreational Activities	Motorized recreation					2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M	
06.1 Recreational Activities	Motorized recreation					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown					8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M	
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Implement demographic monitoring	M	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Cliff-palace milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Low	D	Unknown	Colorado Plateau	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
<i>Astragalus deterior</i>								
Tier 1 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H			
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Implement demographic monitoring	H			
13.6 Response to change, disturbance, & other threats poorly understood	Response to management/disturbance poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	H			
06.1 Recreational Activities	Non-motorized recreation	2.1 Site/Area Management		Manage public use to minimize trampling and surface disturbance	M			
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M			
07.1 Fire & Fire Suppression	Increased fire frequency	2.1 Site/Area Management		Implement compatible forest management practices	M			
08.1 Invasive Non-native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Mancos milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Colorado Plateau	P	Cliffs and Canyons <input checked="" type="checkbox"/>
							Pinyon - Juniper <input type="checkbox"/>
<i>Astragalus humillimus</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	3.1 Species Management		Develop collaborative management agreements with Tribal Leaders to minimize fragmentation and loss from road development and maintenance	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications		Implement landowner outreach/education program	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Skiff milkvetch	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	D	Declining	D	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>

Astragalus microcymbus

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Motorized recreation	1.2 Resource & Habitat Protection	Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
14.4 Predation	Herbivory (e.g., rabbits)	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management	Manage public use to minimize surface disturbance and off trail use	M
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components by continuing long term monitoring	M
01.1 Housing & Urban Areas	Potential residential development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Kremmling milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary
Medium	D	Stable	D	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>

Astragalus osterhoutii

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects	H
06.1 Recreational Activities	Motorized recreation	1.2 Resource & Habitat Protection	Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management	Manage public use to minimize surface disturbance and off road use	H
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
07.2 Dams & Water Management/Use	Fragmentation and loss of native habitat due to dam development & water storage	1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	L
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Schmoll milkvetch	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	D	Declining	D	Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>

Astragalus schmolliae

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Map weed infestations and sensitive no spray/no mow zones	H
08.1 Invasive Non-Native/Alien Species	Invasive plants	8.0 Research & Monitoring	Examine impact of post-fire management strategies	H
08.1 Invasive Non-Native/Alien Species	Invasive plants - especially musk thistle and cheatgrass moving into burned areas	2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.4 Population status unknown	Population status in areas outside National Park is poorly understood	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing management	L
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	2.1 Site/Area Management	Implement compatible practices for transportation projects	L
7.1 Fire & Fire Suppression	Altered fire regime (potential for increased fire extent due to cheatgrass)	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Sleeping Ute milkvetch	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	D	Stable	D	Colorado Plateau	P	Saltbush	<input checked="" type="checkbox"/>

Astragalus tortipes

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Habitat loss and fragmentation from housing development proposed near habitat.	1.2 Resource & Habitat Protection	Work with Tribe to protect habitat and minimize surface disturbance	H
06.1 Recreational Activities	Motorized recreation	1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g. state Natural Area)	H
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H
06.1 Recreational Activities	Motorized recreation	5.3 Private Sector Standards & Codes	Implement Best Management Practices for recreation management	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.6 Response to change, disturbance, & other threats poorly understood	Response to management/disturbance poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Dorn's rockcress		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Unknown	Unknown	Wyoming Basin	P	Barrens	<input checked="" type="checkbox"/>
				Utah-Wyoming Rocky Mountains	O	Pinyon - Juniper	<input type="checkbox"/>
						Ponderosa Pine	<input type="checkbox"/>
						Sagebrush	<input type="checkbox"/>
<i>Boechera glareosa</i>							
Tier 1	Plants						
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Boat-shaped bugseed		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Medium	D	Unknown	Southern Rocky Mountains	P	Sand Dunes Barrens	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Corispermum navicula</i>								
Tier 1 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to minimize surface disturbance and off trail use	H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	H			
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M			
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Heil's tansy mustard	Population Status		Population Trend	Distribution	Type	Habitat	Primary
	Unknown	X	Unknown	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>

Descurainia kenheilli

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Whitlow-grass		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Unknown	Unknown	Southern Rocky Mountains		Alpine	<input checked="" type="checkbox"/>
						Aspen	<input type="checkbox"/>
						Spruce - Fir	<input type="checkbox"/>
<i>Draba malpighiacea</i>							
Tier 1		Plants					
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.3 Genetic relationship with other subspecies unknown	Taxonomic status is uncertain	8.0 Research & Monitoring		Conduct taxonomic and/or genetic research	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Weber's draba		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Low	D	Unknown	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>
							Mountain Streams	<input checked="" type="checkbox"/>
<i>Draba weberi</i>								
Tier 1 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	H			
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Work with land manager to post No Trespassing signage	M			
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction	4.2 Training		Educate dam operator about avoiding and/or mitigating impacts	M			
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction	5.3 Private Sector Standards & Codes		Develop Best Management Practices for water resource management	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Wilken fleabane		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Utah-Wyoming Rocky Mountains	P	Cliffs and Canyons <input checked="" type="checkbox"/>
<i>Erigeron wilkenii</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.3 Genetic relationship with other subspecies unknown	Taxonomic status is uncertain	8.0 Research & Monitoring		Conduct taxonomic and/or genetic research	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Brandegees wild buckwheat	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Low	D	Stable	D	Southern Rocky Mountains	P	Barrens Sagebrush	<input checked="" type="checkbox"/> <input type="checkbox"/>

Eriogonum brandegeei

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Motorized recreation	1.2 Resource & Habitat Protection	Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement	Enforce off-road travel restrictions	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing management	L
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Clay-loving wild buckwheat		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Low	D	Stable	D	Colorado Plateau	P	Saltbush	<input checked="" type="checkbox"/>
		Rapidly declining							
<i>Eriogonum pelinophilum</i>									
Tier 1 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		H			
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		H			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	1.2 Resource & Habitat Protection		Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)		M			
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		M			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Expand and continue long term monitoring		M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Penland alpine fen mustard		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	D	Southern Rocky Mountains		Wetlands	<input checked="" type="checkbox"/>
								Alpine	<input type="checkbox"/>
<i>Eutrema penlandii</i>									
Tier 1 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action	Priority	
06.1 Recreational Activities	Motorized recreation					1.2 Resource & Habitat Protection	Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H	
06.1 Recreational Activities	Motorized recreation					2.1 Site/Area Management	Manage public use to be compatible with biodiversity (e.g. close roads or block access to sensitive areas)	H	
06.1 Recreational Activities	Motorized recreation					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Continue long term monitoring	H	
03.2 Mining & Quarrying	Mining operations					5.3 Private Sector Standards & Codes	Develop and implement Best Management Practices for mining	M	
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)					2.3 Habitat & Natural Process Restoration	Restore natural hydrologic regime	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
14.1 Scarcity	Globally rare and/or small population size					8.0 Research & Monitoring	Research critical life history/habitat components	M	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Lone Mesa snakeweed		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Colorado Plateau	P	Sagebrush <input checked="" type="checkbox"/> Barrens <input type="checkbox"/>
<i>Gutierrezia elegans</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Oil and gas drilling and seismic testing	2.1 Site/Area Management		Manage energy development to limit surface disturbance and fragmentation	H		
06.3 Work & Other Activities	Infrastructure development for visitor use	2.1 Site/Area Management		Design public improvements to avoid surface disturbance and fragmentation of habitat	H		
07.2 Dams & Water Management/Use	Habitat fragmentation and loss from water storage project	2.1 Site/Area Management		Coordinate on ecologically sensitive design of dam and reservoir to minimize flooding and habitat loss	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Mesa Verde stickseed		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Low	D	Stable	D	Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
								Cliffs and Canyons	<input type="checkbox"/>
								Mixed Conifer	<input type="checkbox"/>
<i>Hackelia gracilentia</i>									
Tier 1 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution		H			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		H			
06.1 Recreational Activities	Non-motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring		M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components		M			
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness		L			
7.1 Fire & Fire Suppression	Altered fire regime (potential for increased fire extent due to cheatgrass)	2.3 Habitat & Natural Process Restoration		Restore natural fire regime		L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Pagosa skyrocket		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Declining	D	Southern Rocky Mountains	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
		Rapidly declining						Barrens	<input type="checkbox"/>
								Ponderosa Pine	<input type="checkbox"/>
<i>Ipomopsis polyantha</i>									
Tier 1 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		H			
01.2 Commercial & Industrial Areas	Commercial and industrial development	2.1 Site/Area Management		Manage development to limit surface disturbance and habitat loss		H			
04.2 Utility & Service Lines	Habitat alteration	5.2 Policies & Regulations		Establish mitigation requirements for developments and other projects that impact species/habitats		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	4.3 Awareness & Communications		Implement landowner outreach/education program		M			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management		M			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	8.0 Research & Monitoring		Research species/habitat response to management or disturbance		M			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution		M			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		M			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Continue long term monitoring		M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components		M			
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Map weed infestations and sensitive no spray/no mow zones		L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Coral ipomopsis		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Unknown	X	Unknown	X	Southern Rocky Mountains	P	Spruce - Fir	<input checked="" type="checkbox"/>
								Aspen	<input type="checkbox"/>
								Mixed Conifer	<input type="checkbox"/>
<i>Ipomopsis ramosa</i>									
Tier 1 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution		H			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		H			
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status		H			
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance		H			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Huber's pepperwort	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Unknown X	Unknown	Utah High Plateau	P	Sagebrush	<input checked="" type="checkbox"/>

Lepidium huberi

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Dolores River skeletonplant		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Colorado Plateau	P	Pinyon - Juniper Saltbush
							<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Lygodesmia doloresensis</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	1.2 Resource & Habitat Protection		Expand existing Palisade ACEC to protect off-road habitat	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.3 Genetic relationship with other species and/or subspecies unknown	Taxonomic status is uncertain	8.0 Research & Monitoring		Conduct taxonomic and/or genetic research	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
7.1 Fire & Fire Suppression	Altered fire regime (potential for increased fire extent due to cheatgrass)	2.3 Habitat & Natural Process Restoration		Restore natural fire regime	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Budding monkey flower		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Cliffs and Canyons <input checked="" type="checkbox"/>
							Seeps and Springs <input type="checkbox"/>
							Wetlands <input type="checkbox"/>
<i>Mimulus gemmiparus</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
06.1 Recreational Activities	Non-motorized recreation	2.1 Site/Area Management		Manage public trail use to avoid surface disturbance and fragmentation of habitat	H		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Continue long term monitoring	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	L		

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Table 3 - Continued.

Colorado butterfly plant	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Low	Declining			Wetlands	<input checked="" type="checkbox"/>
<i>Oenothera coloradensis</i> ssp. <i>coloradensis</i>						
Tier 1 Plants						
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration	Maintain and enhance existing hydrologic regime	H		
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	H		
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Map weed infestations and sensitive no spray/no mow zones	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M		

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Table 3 - Continued.

Pikes Peak spring parsley		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		High	D	Stable	D	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>
<i>Oreoxis humilis</i>									
Tier 1 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action	Priority	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance					5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Implement demographic monitoring	H	
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood					8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H	
06.1 Recreational Activities	Non-motorized recreation					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M	
06.1 Recreational Activities	Non-motorized recreation					5.3 Private Sector Standards & Codes	Implement Best Management Practices for recreation management	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown					8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M	
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown					8.0 Research & Monitoring	Research critical life history/habitat components	M	
13.3 Genetic relationship with other subspecies unknown	Taxonomic status is uncertain					8.0 Research & Monitoring	Assess taxonomic status and relationship to <i>Oreoxis alpina</i>	M	
14.1 Scarcity	Globally rare and/or small population size					8.0 Research & Monitoring	Research critical life history/habitat components	M	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Mancos shale packera	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Unknown X	Unknown	Southern Rocky Mountains	P	Barrens	<input checked="" type="checkbox"/>

Packera mancosana

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.3 Genetic relationship with other subspecies unknown	Taxonomic status is uncertain	8.0 Research & Monitoring	Conduct taxonomic and/or genetic research	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Knowlton cactus		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Unknown	Unknown	Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
<i>Pediocactus knowltonii</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	5.4 Compliance & Enforcement		Enforce collecting regulations	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Parachute penstemon		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	D	Southern Rocky Mountains Utah High Plateau	P P	Barrens	<input checked="" type="checkbox"/>
<i>Penstemon debilis</i>									
Tier 1 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action		Priority
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure					5.3 Private Sector Standards & Codes	Work with Occidental Petroleum to Implement Best Management Practices for energy development		H
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure					7.2 Alliance & Partnership Development	Engage Occidental Petroleum in collaborative, proactive planning and conservation programs		H
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure					5.2 Policies & Regulations	Work with state, federal and private partners to limit density of oil/gas leasing and development		H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)		H
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Continue long term monitoring		H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs		M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown					8.0 Research & Monitoring	Conduct field inventory to refine known distribution		M
14.1 Scarcity	Globally rare and/or small population size					8.0 Research & Monitoring	Research critical life history/habitat components		M
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown					8.0 Research & Monitoring	Research critical life history/habitat components		L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Gibben's beardtongue		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown		Wyoming Basin Utah-Wyoming Rocky Mountains	P O <input checked="" type="checkbox"/>
<i>Penstemon gibbensii</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
06.1 Recreational Activities	Motorized recreation	1.2 Resource & Habitat Protection		Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H		
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	5.4 Compliance & Enforcement		Enforce collecting regulations	M		
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Penland penstemon		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	D	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>
<i>Penstemon penlandii</i>									
Tier 1 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action	Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development					1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance					2.1 Site/Area Management	Manage roads to limit disturbance and fragmentation of habitat	H	
04.2 Utility & Service Lines	Habitat alteration					2.1 Site/Area Management	Coordinate with energy companies on ecologically sensitive placement of utility lines to minimize surface disturbance and fragmentation	H	
04.2 Utility & Service Lines	Habitat alteration					5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	H	
06.1 Recreational Activities	Motorized recreation					2.1 Site/Area Management	Manage public use to minimize disturbance and fragmentation of habitat from off road use	H	
06.1 Recreational Activities	Motorized recreation					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Continue demographic monitoring	H	
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus					5.4 Compliance & Enforcement	Enforce collecting regulations	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
14.1 Scarcity	Globally rare and/or small population size					8.0 Research & Monitoring	Research critical life history/habitat components	M	
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

White River penstemon		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Wyoming Basin	P	Barrens <input checked="" type="checkbox"/>
					Utah High Plateau	O	Pinyon - Juniper <input type="checkbox"/>
							Saltbush <input type="checkbox"/>
<i>Penstemon scariosus var. albifluvis</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas development and implement conservation agreement	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	H		
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	5.4 Compliance & Enforcement		Enforce collecting regulations	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

North Park phacelia		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	D	Southern Rocky Mountains	P	Barrens	<input checked="" type="checkbox"/>
<i>Phacelia formosula</i>									
Tier 1 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action	Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development					1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H	
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure					5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development	H	
06.1 Recreational Activities	Motorized recreation					1.2 Resource & Habitat Protection	Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H	
06.1 Recreational Activities	Motorized recreation					2.1 Site/Area Management	Manage public use to minimize surface disturbance and off road use	H	
06.1 Recreational Activities	Motorized recreation					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown					8.0 Research & Monitoring	Conduct field surveys in suitable habitat	H	
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Continue long term monitoring	H	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range					8.0 Research & Monitoring	Research species/habitat response to management or disturbance	M	
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure					5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
14.1 Scarcity	Globally rare and/or small population size					8.0 Research & Monitoring	Research critical life history/habitat components	M	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range					2.1 Site/Area Management	Implement compatible grazing management	L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Troublesome phacelia		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	X Unknown	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>
<i>Phacelia gina-glenneae</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Designate as BLM sensitive species	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H		
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to minimize trampling and surface disturbance	H		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce travel restrictions	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field surveys in suitable habitat	H		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

DeBeque phacelia		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Low	D	Unknown		Utah High Plateau Southern Rocky Mountains	P O	<input checked="" type="checkbox"/>
<i>Phacelia submutica</i>								
Tier 1 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	H			
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H			
04.2 Utility & Service Lines	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Establish mitigation requirements for developments and other projects that impact species/habitats	H			
06.1 Recreational Activities	Motorized recreation	1.2 Resource & Habitat Protection		Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H			
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	H			
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	H			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	M			
13.2 Critical life history/habitat components unknown	Population dynamics and vulnerability to disturbance are poorly known	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Dudley Bluffs bladderpod	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	D	Stable	D	Utah High Plateau	P	Barrens	<input checked="" type="checkbox"/>

Physaria congesta

Tier 1 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure (e.g. roads)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development	H
04.2 Utility & Service Lines	Habitat alteration	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	H
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Piceance twinpod		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	D	Utah High Plateau	P	Barrens	<input checked="" type="checkbox"/>
<i>Physaria obcordata</i>									
Tier 1 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure (e.g. roads)	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		H			
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		H			
04.2 Utility & Service Lines	Habitat alteration	5.2 Policies & Regulations		Establish mitigation requirements for developments and other projects that impact species/habitats		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Continue long term monitoring		H			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes		Implement Best Management Practices for transportation projects		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Cushion bladderpod		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown		Sagebrush Barrens	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Physaria pulvinata</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Oil & gas development and seismic testing	2.1 Site/Area Management		Manage energy development to limit surface disturbance and fragmentation	H		
06.3 Work & Other Activities	Infrastructure development for visitor use at Lone Mesa	2.1 Site/Area Management		Design public improvements to be compatible with biodiversity	H		
07.2 Dams & Water Management/Use	habitat fragmentation and loss from water sotrage project	2.1 Site/Area Management		Coordinate on ecologically sensitive design of dam and reservoir to minimize flooding and habitat loss	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution on private land	H		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Rollins twinpod		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Southern Rocky Mountains	P	Sagebrush <input checked="" type="checkbox"/> Barrens <input type="checkbox"/>
<i>Physaria rollinsii</i>							
Tier 1 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
01.3 Tourism & Recreation Areas	Recreation area development (Signal Peak)	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring		Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

West Silver bladderpod						
Population Status	Population Trend	Distribution	Type	Habitat	Primary	
Unknown	Unknown	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>	
				Barrens	<input type="checkbox"/>	
				Spruce - Fir	<input type="checkbox"/>	
<i>Physaria scrotiformis</i>						
Tier 1 Plants						
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M		
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Colorado hookless cactus		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown		Saltbush	<input checked="" type="checkbox"/>
<i>Sclerocactus glaucus</i>				Colorado Plateau	P		
				Utah High Plateau	P		
				Southern Rocky Mountains	O		
Tier 1 Plants							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining		H
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development		H
04.2 Utility & Service Lines	Habitat alteration			5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats		H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)		H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution		H
13.5 Population trend unknown	Long term population trends unknown			8.0 Research & Monitoring	Continue long term monitoring		H
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure			1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Area of Critical Environmental Concern)		M
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus			5.4 Compliance & Enforcement	Enforce collecting regulations		M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs		M
14.1 Scarcity	Globally rare and/or small population size			8.0 Research & Monitoring	Research critical life history/habitat components		M
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance			5.2 Policies & Regulations	Promote consideration of biodiversity issues in transportation and land use planning processes		L
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus			4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness		L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Mesa Verde hookless cactus		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Low	D	Stable	D	Colorado Plateau	P	Barrens Saltbush	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Sclerocactus mesae-verdae</i>									
Tier 1 Plants									
General Threat	Specific Threat	General Conservation Action			Specific Conservation Action			Priority	
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	5.4 Compliance & Enforcement			Enforce collecting regulations			H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring			Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)			H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation			Seed banking (incl. protocols, collection, and cultivation)			H	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution			H	
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations			Work with industry, tribal, state and federal partners to limit density of oil/gas leasing and development			M	
04.2 Utility & Service Lines	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes			Establish mitigation requirements for developments and other projects that impact species/habitats			M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management			Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs			M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development			Engage in collaborative, proactive planning and conservation programs			M	
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution, abundance, and threat status			M	
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring			Research critical life history/habitat components			M	
14.4 Predation	Insect herbivory	8.0 Research & Monitoring			Research species/habitat response to management or disturbance			M	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes			Work with land owner to implement Best Management Practices for transportation projects			L	
05.2 Gathering Terrestrial Plants	Collection of orchids, cactus	4.3 Awareness & Communications			Publish educational material/sponsor educational programs to raise public awareness			L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Ute ladies'-tresses		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Low	D	Declining	D	Front Range	P	Riparian Woodlands and	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	P	Shrublands	
						Central Shortgrass Prairie	O		
						Utah-Wyoming Rocky Mountains	O		
<i>Spiranthes diluvialis</i>									
Tier 1	Plants								

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	H
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects	H
06.1 Recreational Activities	Non motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration	Restore natural hydrologic regime	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	5.4 Compliance & Enforcement	Enforce 404 wetlands regulations	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
04.2 Utility & Service Lines	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats	M
06.1 Recreational Activities	Non motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M
14.1 Scarcity	Globally rare and/or small population size	8.0 Research & Monitoring	Research critical life history/habitat components	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Tier 2	Plants
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Larimer aletes	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	High	D Stable D	Southern Rocky Mountains	P	Cliffs and Canyons Ponderosa Pine	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Aletes humilis</i>						
Tier 2 Plants						
General Threat	Specific Threat		General Conservation Action	Specific Conservation Action	Priority	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown		8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features		3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.5 Population trend unknown	Long term population trends unknown		8.0 Research & Monitoring	Continue long term monitoring	H	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change		3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)		7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown		8.0 Research & Monitoring	Research critical life history/habitat components	M	
06.1 Recreational Activities	Non-motorized recreation		4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Mesa Verde aletes		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Low	D	Unknown	Colorado Plateau	P	Cliffs and Canyons Pinyon - Juniper	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Aletes maccougallii ssp. breviradiatus</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H			
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H			
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Alcove death camas		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Utah-Wyoming Rocky Mountains	P Cliffs and Canyons Wetlands	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Anticlea vaginatus</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Restore natural hydrologic regime	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Dwarf milkweed		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Declining	D	Central Shortgrass Prairie Southern Rocky Mountains	P O	Shortgrass Prairie	<input checked="" type="checkbox"/>
<i>Asclepias uncialis ssp. uncialis</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		H			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		H			
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		H			
14.2 Low annual recruitment	Population limited by unknown biological requirements	8.0 Research & Monitoring		Research critical life history/habitat components		H			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		M			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management		M			
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring		M			
13.6 Response to change, disturbance, & other threats poorly understood	Response to management/disturbance poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance		M			
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management		L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Gunnison milkvetch		Population Status		Population Trend		Distribution	Type	Habitat	Primary	
		Medium	D	Stable	D	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>	
<i>Astragalus anisus</i>										
Tier 2 Plants										
General Threat	Specific Threat	General Conservation Action				Specific Conservation Action	Priority			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations				Promote consideration of biodiversity in transportation and land use	H			
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management				Manage public use to be compatible with biodiversity	H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring				Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation				Seed banking (incl. protocols, collection, and cultivation)	H			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring				Research critical life history/habitat components	H			
13.6 Response to change, disturbance, & other threats poorly understood	Response to management/disturbance poorly understood	8.0 Research & Monitoring				Research species/habitat response to management or disturbance	H			
01.1 Housing & Urban Areas	Rural and ex-urban development	1.2 Resource & Habitat Protection				Acquire conservation easement for habitat protection	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management				Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development				Engage in collaborative, proactive planning and conservation programs	M			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management				Implement compatible grazing management	L			
06.1 Recreational Activities	Non-motorized recreation (e.g. mountain bikes)	4.3 Awareness & Communications				Publish educational material/sponsor educational programs to raise public awareness	L			
07.1 Fire & Fire Suppression	Altered fire regime (potential for increased fire extent due to cheatgrass)	2.3 Habitat & Natural Process Restoration				Restore natural fire regime	L			
08.1 Invasive Non-Native/Alien Species	Invasive plants (especially cheatgrass)	2.2 Invasive/Problematic Species Control				Develop and/or implement integrated weed management	L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Cronquist milkvetch	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Low	D	Unknown	D	Colorado Plateau	P	Saltbush	<input checked="" type="checkbox"/>

Astragalus cronquistii

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

DeBeque milkvetch		Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	D	Declining	D		Southern Rocky Mountains	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
						Utah High Plateau	P	Barrens	<input type="checkbox"/>
						Colorado Plateau	O	Saltbush	<input type="checkbox"/>
<i>Astragalus debequaeus</i>									
Tier 2 Plants									
General Threat	Specific Threat			General Conservation Action		Specific Conservation Action		Priority	
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure			1.2 Resource & Habitat Protection		Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)		H	
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure			5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		H	
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			2.1 Site/Area Management		Implement compatible grazing practices		M	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance			5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use		M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring		Conduct field inventory to refine known distribution		M	
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown			8.0 Research & Monitoring		Research critical life history/habitat components		M	
13.5 Population trend unknown	Long term population trends unknown			8.0 Research & Monitoring		Continue long term monitoring		M	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Horseshoe milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Colorado Plateau	P	Pinyon - Juniper <input checked="" type="checkbox"/>
<i>Astragalus equisolensis</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
06.1 Recreational Activities	Non motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.3 Genetic relationship unknown	Taxonomic status is uncertain	8.0 Research & Monitoring		Conduct taxonomic and/or genetic research	M		
07.1 Fire & Fire Suppression	Altered fire regime (potential for increased fire extent due to cheatgrass)	2.3 Habitat & Natural Process Restoration		Restore natural fire regime	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Violet milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown			
				Colorado Plateau	P	Sagebrush	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Mixed Conifer	<input type="checkbox"/>
<i>Astragalus iodopetalus</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.3 Genetic relationship unknown	Taxonomic status is uncertain	8.0 Research & Monitoring		Conduct taxonomic and/or genetic research	H		
06.1 Recreational Activities	Non-motorized recreation	5.3 Private Sector Standards & Codes		Implement Best Management Practices for recreation management	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Missouri milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Low	D	Unknown	Southern Rocky Mountains	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
<i>Astragalus missouriensis</i> <i>var. humistratus</i>								<input type="checkbox"/>
Tier 2 Plants								<input type="checkbox"/>
								<input type="checkbox"/>
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown			8.0 Research & Monitoring	Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance			5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown			8.0 Research & Monitoring	Implement demographic monitoring	M		
08.1 Invasive Non-Native/Alien Species	Invasive plants			2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Naturita milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown			
<i>Astragalus naturitensis</i>				Colorado Plateau	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Pinyon - Juniper	<input type="checkbox"/>
				Utah High Plateau	O	Sagebrush	<input type="checkbox"/>
Tier 2 Plants							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority	
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure			5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	H	
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.4 Population status unknown	Current population status unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance			5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M	
06.1 Recreational Activities	Motorized recreation			2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Fisher Towers milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Medium	D	Unknown	Colorado Plateau	P	Pinyon - Juniper Saltbush	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Astragalus piscator</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			
07.1 Fire & Fire Suppression	Altered fire regime (potential for increased fire extent due to cheatgrass)	2.3 Habitat & Natural Process Restoration		Restore natural fire regime	L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

San Rafael milkvetch	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Low	D Unknown	Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>

Astragalus rafaensis

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Front Range milkvetch		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	X Unknown	Front Range	P	Mixed Conifer	<input checked="" type="checkbox"/>
<i>Astragalus sparsiflorus</i>							
Tier 2		Plants					
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	L		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Crandall's rock-cess		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Unknown	Unknown	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>
<i>Boechera crandallii</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Narrowleaf grape fern		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D Declining	Southern Rocky Mountains	P	Aspen	<input checked="" type="checkbox"/>
						Foothill and Mountain Grasslands	<input type="checkbox"/>
						Mixed Conifer	<input type="checkbox"/>
<i>Botrychium lineare</i>							
Tier 2	Plants						
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	M		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M		
13.4 Populaiton status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	M		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Cisco sego lily		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Unknown	X	Unknown		Utah High Plateau Colorado Plateau	P O	<input checked="" type="checkbox"/>
<i>Calochortus ciscoensis</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H			
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Eastwood evening primrose		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	X Unknown	Colorado Plateau	P	Saltbush Pinyon - Juniper	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Camissonia eastwoodiae</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M		
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	M		
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Downy Indian paintbrush		Population Status	Population Trend	Distribution	Type	Habitat	Primary		
		Medium	D	Unknown		Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>
<i>Castilleja puberula</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action			Specific Conservation Action	Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring			Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation			Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution	H			
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution, abundance, and threat status	H			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management			Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development			Engage in collaborative, proactive planning and conservation programs	M			
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications			Publish educational material/sponsor educational programs to raise public awareness	L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Adobe thistle		Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Low	D	Stable	D	Colorado Plateau	P	Sagebrush	<input checked="" type="checkbox"/>	
					Southern Rocky Mountains	P	Saltbush	<input type="checkbox"/>	
					Utah High Plateau	P			
<i>Cirsium perplexans</i>									
Tier 2 Plants									
General Threat	Specific Threat			General Conservation Action		Specific Conservation Action		Priority	
08.1 Invasive Non-Native/Alien Species	Bio-control of non-native <i>Cirsium</i> species			2.2 Invasive/Problematic Species Control		Design weed control activities to avoid native thistles and develop methods for mitigating impacts from bio-control agents such as introduced weevils		H	
08.1 Invasive Non-Native/Alien Species	Mis-identification of native thistles in weed control efforts			4.3 Awareness & Communications		Educate land owners, managers, and those engaged in weed control about avoiding impacts to native thistles		H	
08.1 Invasive Non-Native/Alien Species	Mis-identification of native thistles in weed control efforts			4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness		H	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring		Conduct field inventory to refine known distribution of natural occurrences		M	
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown			8.0 Research & Monitoring		Research critical life history/habitat components		M	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			2.1 Site/Area Management		Implement compatible grazing management		L	
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure			5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		L	
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure			5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		L	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance			5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use		L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Slender spiderflower		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Declining	D	Southern Rocky Mountains	P	Wetlands Playas	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Cleome multicaulis</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
02.1 Annual & Perennial Non-Timber Crops	Hydrological alterations to support potato, and other crop production	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		H			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Establish legal designation to protect habitat (e.g., Area of Critical Environmental Concern)		H			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management		H			
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Restore natural hydrologic regime		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring		H			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Colorado larkspur		Population Status	Population Trend	Distribution	Type	Habitat	Primary		
		Medium	D	Unknown		Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>
<i>Delphinium ramosum var. alpestre</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action			Specific Conservation Action		Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring			Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation			Seed banking (incl. protocols, collection, and cultivation)		H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution		H		
13.3 Genetic relationship with other subspecies unknown	Taxonomic status is uncertain	8.0 Research & Monitoring			Conduct taxonomic and/or genetic research		H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution, abundance, and threat status		H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management			Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development			Engage in collaborative, proactive planning and conservation programs		M		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications			Publish educational material/sponsor educational programs to raise public awareness		L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Wahatoya Creek larkspur		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Unknown	X Unknown	Southern Rocky Mountains	P	Aspen	<input checked="" type="checkbox"/>
<i>Delphinium robustum</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.3 Genetic relationship with other subspecies unknown	Taxonomic status is uncertain	8.0 Research & Monitoring		Conduct taxonomic and/or genetic research	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	M		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Clawless draba	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Low	D	Stable	D	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>

Draba exunguiculata

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
08.2 Problematic Native Species	Trampling by mountain goats	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	L
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

San Juan whitlow-grass		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Alpine <input checked="" type="checkbox"/>
<i>Draba graminea</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Gray's Peak whitlow-grass	Population Status		Population Trend	Distribution	Type	Habitat	Primary
	Medium	X	Unknown	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>

Draba grayana

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
08.2 Problematic Native Species	Trampling by mountain goats	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	L
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Smith whitlow-grass		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Cliffs and Canyons <input checked="" type="checkbox"/>
							Aspen <input type="checkbox"/>
							Mixed Conifer <input type="checkbox"/>
							Upland Shrub <input type="checkbox"/>
<i>Draba smithii</i>							
Tier 2	Plants						
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Kachina daisy		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		High	D Unknown	Colorado Plateau	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
<i>Erigeron kachinensis</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Maintain natural hydrologic regime	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Comb Wash buckwheat		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D Unknown	Colorado Plateau	P	Saltbush	<input checked="" type="checkbox"/>
<i>Eriogonum clavellatum</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Colorado wild buckwheat		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Medium	D	Unknown	Southern Rocky Mountains	P	Alpine Foothill and Mountain Grasslands	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Eriogonum coloradense</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H			
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management	M			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Colorado green gentian	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	X	Declining	X	Central Shortgrass Prairie	P	Shortgrass Prairie	<input checked="" type="checkbox"/>

Frasera coloradensis

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing management	M
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Canadian River spiny aster	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Low	D	Unknown		Southern Rocky Mountains	P

Herrickia horrida

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Rabbit Ears gilia	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Low	D	Unknown	Southern Rocky Mountains	P	Mixed Conifer <input checked="" type="checkbox"/>

Ipomopsis aggregata ssp. weberi

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	H
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H
13.3 Genetic relationship with other subspecies unknown	Genetics of isolated populations poorly understood	8.0 Research & Monitoring	Genetic studies to determine the isolation and genetic diversity of disparate occurrences	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
02.3 Livestock Farming & Ranching	Grazing and trampling by native and non-native ungulates	2.1 Site/Area Management	Implement compatible grazing management	M
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	L
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	L
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	L
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	L
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Globe gilia		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Alpine <input checked="" type="checkbox"/>
<i>Ipomopsis globularis</i>							
Tier 2 Plants							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority	
03.2 Mining & Quarrying	Mining operations			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H	
06.1 Recreational Activities	Motorized recreation			2.1 Site/Area Management	Manage public use to be compatible with biodiversity	H	
06.1 Recreational Activities	Non-motorized recreation			4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance			5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M	
08.1 Invasive Non-Native/Alien Species	Invasive plants			2.2 Invasive/Problematic Species Control	Monitor occurrences for weed invasion and control promptly	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M	
13.6 Response to change, disturbance, & other threats poorly understood	Response to management/disturbance poorly understood			8.0 Research & Monitoring	Research species/habitat response to management or disturbance	M	
05.2 Gathering Terrestrial Plants	Collecting for rock gardens			4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	L	
05.2 Gathering Terrestrial Plants	Collecting for rock gardens			5.4 Compliance & Enforcement	Enforce collecting regulations	L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Alkaline pepperwort		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown			
<i>Lepidium crenatum</i>				Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Greasewood	<input type="checkbox"/>
Tier 2 Plants				Utah-Wyoming Rocky Mountains	P	Sagebrush	<input type="checkbox"/>
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H	
13.4 Population status unknown	Current population status unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H	
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood			8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	This species is difficult to distinguish from invasive <i>Lepidium latifolium</i>			4.3 Awareness & Communications	Implement landowner outreach/education program	M	
07.1 Fire & Fire Suppression	Piling and burning slash from hazardous fuels reduction projects			4.3 Awareness & Communications	Implement landowner outreach/education program	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development	Coordinate with related agencies to align goals, policies, measures of success, etc.	M	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Alcove bog orchid		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Utah-Wyoming Rocky Mountains	P	Cliffs and Canyons <input checked="" type="checkbox"/>
							Seeps and Springs <input type="checkbox"/>
							Wetlands <input type="checkbox"/>
<i>Limnorchis zothecina</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Restore natural hydrologic regime	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Colorado desert-parsley		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Declining	D	Colorado Plateau	P	Sagebrush	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	O	Barrens	<input type="checkbox"/>
<i>Lomatium concinnum</i>									
Tier 2 Plants									
General Threat	Specific Threat			General Conservation Action		Specific Conservation Action		Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		H	
06.1 Recreational Activities	Motorized Recreation			2.1 Site/Area Management		Manage public use to be compatible with biodiversity		H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H	
13.4 Population status unknown	Current population status unknown			8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status		H	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M	
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown			8.0 Research & Monitoring		Research critical life history/habitat components		M	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Payson lupine		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown			
				Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P	Barrens	<input type="checkbox"/>
<i>Lupinus crassus</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management	M		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	M		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M		
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration		Restore natural fire regime	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Paradox stickleaf		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Unknown	Unknown	Colorado Plateau	P	Saltbush	<input checked="" type="checkbox"/>
<i>Mentzelia paradoxensis</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	M		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Roan Cliffs blazing star		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown		Barrens	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P		
				Utah High Plateau	P		
<i>Mentzelia rhizomata</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	1.2 Resource & Habitat Protection		Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Rocky Mountain bluebells	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Low	D Unknown	Southern Rocky Mountains	P	Sagebrush	<input checked="" type="checkbox"/>

Mertensia humilis

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution, abundance, and threat status	H
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Golden blazing star		Population Status		Population Trend		Distribution		Type	Habitat	Primary
		Low	D	Declining	D	Central Shortgrass Prairie		P	Barrens	<input checked="" type="checkbox"/>
						Southern Rocky Mountains		O	Pinyon - Juniper	<input type="checkbox"/>
<i>Nuttallia chrysantha</i>										
Tier 2 Plants										
General Threat	Specific Threat			General Conservation Action		Specific Conservation Action			Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection			H	
03.2 Mining & Quarrying	Mining (limestone)			1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection			H	
03.2 Mining & Quarrying	Mining (limestone)			4.2 Training		Educate development industries about avoiding and/or mitigating impacts to rare or sensitive species			H	
06.1 Recreational Activities	Motorized recreation			4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness			H	
06.1 Recreational Activities	Motorized recreation			5.4 Compliance & Enforcement		Enforce off-road travel restrictions			H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)			H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)			H	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance			5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use			M	
04.2 Utility & Service Lines	Habitat alteration			5.3 Private Sector Standards & Codes		Implement Best Management Practices for urban development, landscaping, etc.			M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs			M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs			M	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			2.1 Site/Area Management		Implement compatible grazing management			L	
08.1 Invasive Non-Native/Alien Species	Invasive plants			2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management			L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Arkansas Canyon stickleaf		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Low	D	Unknown	Southern Rocky Mountains	P	Pinyon - Juniper Upland Shrub	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Nuttallia densa</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	H			
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	4.3 Awareness & Communications		Implement landowner outreach/education program	M			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M			
06.1 Recreational Activities	Non motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M			
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Narrow-leaf evening primrose		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown		Utah-Wyoming Rocky Mountains	<input checked="" type="checkbox"/>
				Wyoming Basin	O	Wetlands	<input type="checkbox"/>
<i>Oenothera acutissima</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management	H		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Maintain and restore natural hydrologic regime	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Rayless goldenweed		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Central Shortgrass Prairie Southern Rocky Mountains	P O	Shortgrass Prairie <input checked="" type="checkbox"/>
<i>Oenopsis foliosa</i> var. <i>monocephala</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
04.2 Utility and Service Lines	Habitat alteration	5.3 Private Sector Standards & Codes		Implement Best Management Practices for urban development, landscaping, etc.	M		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Pueblo goldenweed		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Declining	D	Central Shortgrass Prairie	P	Shortgrass Prairie	<input checked="" type="checkbox"/>
								Barrens	<input type="checkbox"/>
<i>Oenopsis puebloensis</i>									
Tier 2 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action	Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development					1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
03.2 Mining & Quarrying	Mining (limestone)					1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H	
03.2 Mining & Quarrying	Mining (limestone)					4.2 Training	Educate development industries about avoiding and/or mitigating impacts to rare or sensitive species	H	
06.1 Recreational Activities	Motorized recreation					4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H	
06.1 Recreational Activities	Motorized recreation					5.4 Compliance & Enforcement	Enforce off-road travel restrictions	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown					8.0 Research & Monitoring	Research critical life history/habitat components	H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development					4.3 Awareness & Communications	Implement landowner outreach/education program	M	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance					5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M	
04.2 Utility & Service Lines	Habitat alteration					5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Implement demographic monitoring	M	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range					2.1 Site/Area Management	Implement compatible grazing management	L	
08.1 Invasive Non-Native/Alien Species	Invasive plants					2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Osterhout cat's-eye		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Low	D	Stable	D	Colorado Plateau	P	Barrens	<input checked="" type="checkbox"/>
								Pinyon - Juniper	<input type="checkbox"/>
								Saltbush	<input type="checkbox"/>
<i>Oreocarya osterhoutii</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution		H			
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance		H			
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness		M			
07.1 Fire & Fire Suppression	Altered fire regime in pinyon juniper habitat	2.3 Habitat & Natural Process Restoration		Restore natural fire regime		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Gypsum Valley cat's-eye		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	X Unknown	Colorado Plateau	P	Saltbush	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	O	Barrens	<input type="checkbox"/>
<i>Oreocarya revealii</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H		
06.1 Recreational Activities	Motorized recreation	1.2 Resource & Habitat Protection		Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H		
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Round-leaf four o'clock	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	D	Declining	D	Central Shortgrass Prairie	P	Barrens	<input checked="" type="checkbox"/>

Oxybaphus rotundifolius

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H
03.2 Mining & Quarrying	Mining (limestone)	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
03.2 Mining & Quarrying	Mining (limestone)	4.2 Training	Educate development industries about avoiding and/or mitigating impacts to rare or sensitive species	H
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	H
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement	Enforce off-road travel restrictions	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Implement demographic monitoring	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	4.3 Awareness & Communications	Implement landowner outreach/education program	M
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M
04.2 Utility & Service Lines	Habitat alteration	5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring	Research critical life history/habitat components	M
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing management	L
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	L

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Bessey locoweed		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Wyoming Basin Utah High Plateau	P Sagebrush	<input checked="" type="checkbox"/>
<i>Oxytropis besseyi</i> var. <i>obnapiformis</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	M		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Yampa beardtongue		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	X	Unknown	Wyoming Basin Utah-Wyoming Rocky Mountains	P O	Sagebrush <input checked="" type="checkbox"/>
<i>Penstemon acaulis</i> var. <i>yampaensis</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management	M		
05.2 Gathering Terrestrial Plants	Collecting for gardens	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
05.2 Gathering Terrestrial Plants	Collecting for gardens	5.4 Compliance & Enforcement		Enforce collecting regulations	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Degener beardtongue		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Medium	D	Unknown	Southern Rocky Mountains	P	Pinyon - Juniper Foothill and Mountain Grasslands	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Penstemon degeneri</i>								
Tier 2 Plants								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
06.1 Recreational Activities	Motorized recreation			2.1 Site/Area Management	Manage public use to be compatible with biodiversity	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown			8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features			3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H		
05.2 Gathering Terrestrial Plants	Collecting for gardens			4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M		
05.2 Gathering Terrestrial Plants	Collecting for gardens			5.4 Compliance & Enforcement	Enforce collecting regulations	M		
06.1 Recreational Activities	Non-motorized recreation			4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M		
07.1 Fire & Fire Suppression	Altered fire regime			2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M		
08.1 Invasive Non-Native/Alien Species	Invasive plants			2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	M		
08.1 Invasive Non-Native/Alien Species	Invasive plants			2.2 Invasive/Problematic Species Control	Map weed infestations and sensitive no spray/no mow zones	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change			3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)			7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown			8.0 Research & Monitoring	Research critical life history/habitat components	M		
13.5 Population trend unknown	Long term population trends unknown			8.0 Research & Monitoring	Implement demographic monitoring	M		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood			8.0 Research & Monitoring	Research species/habitat response to management or disturbance	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Fremont's beardtongue		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown	Utah High Plateau	Pinyon - Juniper	<input checked="" type="checkbox"/>
					Wyoming Basin	Sagebrush	<input type="checkbox"/>
<i>Penstemon fremontii</i> var. <i>glabrescens</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	H		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	M		
05.2 Gathering Terrestrial Plants	Collecting for gardens	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
05.2 Gathering Terrestrial Plants	Collecting for gardens	5.4 Compliance & Enforcement		Enforce collecting regulations	M		
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management		Manage public use to be compatible with biodiversity	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Graham beardtongue		Population Status		Population Trend		Distribution	Type	Habitat	Primary	
		Low	D	Stable	D	Wyoming Basin	P	Barrens	<input checked="" type="checkbox"/>	
		Pinyon - Juniper								<input type="checkbox"/>
<i>Penstemon grahamii</i>										
Tier 2 Plants										
General Threat	Specific Threat		General Conservation Action		Specific Conservation Action		Priority			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure		1.2 Resource & Habitat Protection		Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)		H			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure		5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		H			
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure		5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		H			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance		5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown		8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features		3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.4 Population status unknown	Current population status unknown		8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status		H			
13.5 Population trend unknown	Long term population trends unknown		8.0 Research & Monitoring		Continue long term monitoring		H			
05.2 Gathering Terrestrial Plants	Collecting for gardens		4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness		M			
05.2 Gathering Terrestrial Plants	Collecting for gardens		5.4 Compliance & Enforcement		Enforce collecting regulations		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change		3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)		7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Grand Mesa penstemon		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	X	Southern Rocky Mountains	P	Aspen	<input checked="" type="checkbox"/>
								Foothill and Mountain Grasslands	<input type="checkbox"/>
								Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
<i>Penstemon mensarum</i>									
Tier 2	Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		H			
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status		H			
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use		M			
05.2 Gathering Terrestrial Plants	Collecting for gardens	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness		M			
05.2 Gathering Terrestrial Plants	Collecting for gardens	5.4 Compliance & Enforcement		Enforce collecting regulations		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Plateau penstemon		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	D	Utah-Wyoming Rocky Mountains	P	Pinyon - Juniper Sagebrush	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Penstemon scariosus</i> var. <i>cyanomontanus</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action			Specific Conservation Action			Priority	
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes			Implement Best Management Practices for energy development and mining			H	
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations			Work with state and federal partners to limit density of oil/gas leasing and development			H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring			Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)			H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation			Seed banking (incl. protocols, collection, and cultivation)			H	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution			H	
05.2 Gathering Terrestrial Plants	Collecting for gardens	4.3 Awareness & Communications			Publish educational material/sponsor educational programs to raise public awareness			M	
05.2 Gathering Terrestrial Plants	Collecting for gardens	5.4 Compliance & Enforcement			Enforce collecting regulations			M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management			Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs			M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development			Engage in collaborative, proactive planning and conservation programs			M	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management			Implement compatible grazing management			L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Avery Peak twinpod		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Unknown	Unknown	Southern Rocky Mountains	P	Alpine	<input checked="" type="checkbox"/>
<i>Physaria alpina</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Bell's twinpod		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Declining	D	Central Shortgrass Prairie Front Range	P P	Barrens	<input checked="" type="checkbox"/>
<i>Physaria bellii</i>									
Tier 2 Plants									
General Threat	Specific Threat					General Conservation Action	Specific Conservation Action	Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development					1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H	
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance					5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	H	
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown					8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H	
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features					3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H	
13.5 Population trend unknown	Long term population trends unknown					8.0 Research & Monitoring	Continue long term monitoring	H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development					8.0 Research & Monitoring	Monitor population status	M	
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change					3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M	
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)					7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown					8.0 Research & Monitoring	Conduct field inventory to refine known distribution	L	

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Piceance bladderpod		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	X	Utah High Plateau	P	Barrens	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	O		
<i>Physaria parviflora</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		H			
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status		H			
08.1 Invasive Non-Native/Alien Species	Invasive plants (including leafy spurge)	2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Pagosa bladderpod	Population Status		Population Trend	Distribution	Type	Habitat	Primary
	Medium	D	Unknown	Southern Rocky Mountains	P	Barrens	<input checked="" type="checkbox"/>

Physaria pruinosa

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes	Implement Best Management Practices for energy development and mining	M
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations	Work with state and federal partners to limit density of oil/gas leasing and development	M
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations	Promote consideration of biodiversity in transportation and land use	M
06.1 Recreational Activities	Motorized recreation	4.3 Awareness & Communications	Publish educational material/sponsor educational programs to raise public awareness	M
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Develop and/or implement integrated weed management	M
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Map weed infestations and sensitive no spray/no mow zones	M
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Good-neighbor bladderpod		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	Unknown	Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
<i>Physaria vicina</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Rocky Mountain cinquefoil		Population Status		Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
<i>Potentilla rupincola</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action			Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring			Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation			Seed banking (incl. protocols, collection, and cultivation)	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations			Promote consideration of biodiversity in transportation and land use	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management			Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development			Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring			Implement demographic monitoring	M		
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control			Map weed infestations and sensitive no spray/no mow zones	L		
08.1 Invasive Non-Native/Alien Species	Invasive plants	8.0 Research & Monitoring			Monitor populations for introduction of new weeds	L		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring			Research species/habitat response to management or disturbance	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Porter feathergrass	Population Status		Population Trend		Distribution	Type	Habitat	Primary
	Medium	D	Declining	D	Southern Rocky Mountains	P	Wetlands	<input checked="" type="checkbox"/>

Ptilagrostis porteri

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
03.2 Mining & Quarrying	Mining (peat, placer)	1.2 Resource & Habitat Protection	Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)	H
03.2 Mining & Quarrying	Mining (peat, placer)	4.2 Training	Educate miners about avoiding and/or mitigating impacts	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	1.2 Resource & Habitat Protection	Establish in-stream flow rights	H
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration	Restore natural hydrologic regime	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Continue long term monitoring	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	M
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	M
13.6 Response to change, disturbance, & other threats poorly understood	Response to management/disturbance poorly understood	8.0 Research & Monitoring	Research species/habitat response to management or disturbance	M
13.6 Response to change, disturbance, & other threats poorly understood	Restoration techniques are poorly understood	8.0 Research & Monitoring	Seed banking and identification of effective restoration methods	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Parish's alkali grass		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Wetlands <input checked="" type="checkbox"/>
<i>Puccinellia parishii</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
07.2 Dams & Water Management/Use	Altered hydrological regime (surface or aquifer)	2.3 Habitat & Natural Process Restoration		Maintain natural hydrologic regime	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management	M		
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Arizona willow	Population Status	Population Trend	Distribution	Type	Habitat	Primary
	Low	D Unknown	Southern Rocky Mountains	P	Wetlands	<input checked="" type="checkbox"/>

Salix arizonica

Tier 2 Plants

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management	Implement compatible grazing management	H
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring	Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation	Seed banking (incl. protocols, collection, and cultivation)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Conduct field inventory to refine known distribution	H
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring	Implement demographic monitoring	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management	Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development	Engage in collaborative, proactive planning and conservation programs	M

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Weber saussurea		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Alpine <input checked="" type="checkbox"/>
<i>Saussurea weberi</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history (e.g., is species rhizomatous?)/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
03.2 Mining & Quarrying	Mining operations	5.3 Private Sector Standards & Codes		Implement Best Management Practices for mining	M		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

James telesonix		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Cliffs and Canyons <input checked="" type="checkbox"/>
							Alpine <input type="checkbox"/>
							Mixed Conifer <input type="checkbox"/>
<i>Telesonix jamesii</i>							
Tier 2	Plants						
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Sun-loving meadow rue		Population Status		Population Trend		Distribution	Type	Habitat	Primary
		Medium	D	Stable	D	Utah High Plateau	P	Barrens	<input checked="" type="checkbox"/>
						Southern Rocky Mountains	O		
<i>Thalictrum heliophilum</i>									
Tier 2 Plants									
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action		Priority			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection		H			
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining		H			
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development		H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Monitor for the presence of noxious weeds and implement weed control immediately if detected		M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components		M			
13.5 Population trend unknown	Long term population trends unknown	8.0 Research & Monitoring		Implement demographic monitoring		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Juniper tumble mustard		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	X	Unknown			
				Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	O	Sagebrush	<input type="checkbox"/>
				Utah High Plateau	O		
<i>Thelypodopsis juniperorum</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management	M		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
03.1 Oil & Gas Drilling	Fragmentation of native habitat due to oil/gas development & associated infrastructure	5.3 Private Sector Standards & Codes		Implement Best Management Practices for energy development and mining	L		
03.1 Oil & Gas Drilling	Oil & gas development, pipelines, and infrastructure	5.2 Policies & Regulations		Work with state and federal partners to limit density of oil/gas leasing and development	L		
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Northwestern thelypody		Population Status		Population Trend		Distribution		Type	Habitat	Primary
		Unknown	D	Unknown		Southern Rocky Mountains Wyoming Basin		P O	Wetlands	<input checked="" type="checkbox"/>
<i>Thelypodium paniculatum</i>										
Tier 2 Plants										
General Threat	Specific Threat		General Conservation Action		Specific Conservation Action		Priority			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown		8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)		H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features		3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)		H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown		8.0 Research & Monitoring		Conduct field inventory to refine known distribution		H			
13.4 Population status unknown	Current population status unknown		8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status		H			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change		3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs		M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)		7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs		M			
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood		8.0 Research & Monitoring		Research species/habitat response to management or disturbance		M			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Fendler's townsend-daisy		Population Status	Population Trend	Distribution	Type	Habitat	Primary	
		Low	D	Unknown		Central Shortgrass Prairie Southern Rocky Mountains	P P	<input checked="" type="checkbox"/>
<i>Townsendia fendleri</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	H			
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H			
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	H			
13.3 Genetic relationship with other species and/or subspecies unknown	Taxonomic status is uncertain	8.0 Research & Monitoring		Conduct taxonomic and/or genetic research	H			
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement		Enforce off-road travel restrictions	M			
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management	M			
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Map weed infestations and sensitive no spray/no mow zones	M			
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M			
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M			
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.1 Site/Area Management		Implement compatible grazing management	L			

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Gray's townsend-daisy		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	D	Unknown		Barrens	<input checked="" type="checkbox"/>
				Southern Rocky Mountains	P		
				Colorado Plateau	O		
<i>Townsendia glabella</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	H		
04.1 Roads & Railroads	Fragmentation and/or ROW maintenance	5.2 Policies & Regulations		Promote consideration of biodiversity in transportation and land use	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	H		
06.3 Work & Other Activities	This species is difficult to distinguish from other more common <i>Townsendia</i>	4.3 Awareness & Communications		Careful identification and marking for avoidance	M		
07.1 Fire & Fire Suppression	Piling and burning slash from hazardous fuels reduction projects	4.3 Awareness & Communications		Careful identification and marking for avoidance	M		
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Develop and/or implement integrated weed management	M		
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control		Map weed infestations and sensitive no spray/no mow zones	M		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
06.1 Recreational Activities	Non-motorized recreation	4.3 Awareness & Communications		Publish educational material/sponsor educational programs to raise public awareness	L		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Rothrock townsend-daisy		Population Status		Population Trend	Distribution	Type	Habitat	Primary
		Medium	D	Unknown	Southern Rocky Mountains	P	Alpine Spruce - Fir	<input checked="" type="checkbox"/> <input type="checkbox"/>
<i>Townsendia rothrockii</i>								
Tier 2 Plants								
General Threat	Specific Threat	General Conservation Action			Specific Conservation Action	Priority		
06.1 Recreational Activities	Motorized recreation	5.4 Compliance & Enforcement			Enforce off-road travel restrictions	H		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring			Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation			Seed banking (incl. protocols, collection, and cultivation)	H		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution, abundance, and threat status	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management			Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development			Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring			Conduct field inventory to refine known distribution	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring			Research critical life history/habitat components	M		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring			Research species/habitat response to management or disturbance	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Table 3 - Continued.

Whip-root clover		Population Status	Population Trend	Distribution	Type	Habitat	Primary
		Low	X	Unknown	Central Shortgrass Prairie	P	Shortgrass Prairie <input checked="" type="checkbox"/>
<i>Trifolium dasyphyllum ssp. anemophilum</i>							
Tier 2 Plants							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority		
11.1 Habitat Shifting & Alteration	Phenological response to climate change of species itself and/or inter-dependent species unknown	8.0 Research & Monitoring		Conduct primary research on rare plant and pollinator responses to changing climate, and other vulnerability factors (dispersal mechanisms, mutualisms)	H		
11.1 Habitat Shifting & Alteration	Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features	3.4 Ex-Situ Conservation		Seed banking (incl. protocols, collection, and cultivation)	H		
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	3.1 Species Management		Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs	M		
11.2 Droughts	Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados, etc.)	7.2 Alliance & Partnership Development		Engage in collaborative, proactive planning and conservation programs	M		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution	M		
13.2 Critical life history/habitat components unknown	Reproductive and/or pollination biology and specific habitat parameters unknown	8.0 Research & Monitoring		Research critical life history/habitat components	M		
13.4 Population status unknown	Current population status unknown	8.0 Research & Monitoring		Conduct field inventory to refine known distribution, abundance, and threat status	M		
13.6 Response to change, disturbance, & other threats poorly understood	Threats are poorly understood	8.0 Research & Monitoring		Research species/habitat response to management or disturbance	M		

X = Best professional judgement, D = Science-based decision, P = Primary area of distribution, O = Other areas where species occurs.

Part 6: STRATEGIES FOR MONITORING SPECIES, AND SUCCESS OF CONSERVATION ACTIONS

Species Monitoring

Twenty-three Plants of Greatest Conservation Need (PGCN) are currently being monitored to help understand long-term trends and/or impacts of various land use activities (Table 4). Priorities for additional species monitoring are the Tier 1 PGCN that are not currently being monitored, and the Tier 2 PGCN with suspected downward trends. These species were identified as in need of monitoring through various sources including Colorado's Biodiversity Scorecard (CNHP and TNC 2011) and the expert opinion of Colorado's scientific community, via the RPCI and the stakeholders who reviewed this document. There are twelve Tier 1 species which list 'Implement Demographic Monitoring' as a conservation action to determine long term population trends. Species for which monitoring was rated as an urgent priority are indicated with an *.

High Priority Tier 1 species in need of monitoring:

Aletes latilobus
Aliciella sedifolia
*Corispermum navicula**
*Draba weberi**
Erigeron wilkenii
Hackelia gracilentia
Lygodesmia doloresensis
*Oreoxis humilis**
Penstemon gibbensii
Penstemon scariosus var. *albifluvis**
*Phacelia submutica**
Physaria pulvinata

Twenty Tier 2 species were identified in the Threats and Actions section (Part 5) of this document as in need of monitoring to determine long term population trends. Species for which monitoring was rated as an urgent priority are indicated with an *.

High Priority Tier 2 species in need of monitoring:

Asclepias uncialis ssp. *uncialis*
Astragalus missouriensis var. *humistratus*
Astragalus sparsiflorus
Calochortus ciscoensis
Camissonia eastwoodiae
Oonopsis puebloensis
Oreocarya revealii
*Oxybaphus rotundifolius**
Penstemon degeneri
Physaria vicina

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*Cleome multicaulis**
Limnorchis zothecina
Mentzelia rhizomata
Nuttallia densa
*Oenothera acutissima**

Potentilla rupincola
Puccinellia parishii
*Salix arizonica**
Telesonix jamesii
Thalictrum helinophilum

Recommended monitoring actions include:

- Prioritize monitoring needs for PGCN annually (for example, during Annual Colorado Rare Plant Technical Committee Symposia, Biodiversity Scorecard updates, etc.), and share priorities with the scientific and academic communities, and interested public groups.
- Support existing and establish new monitoring projects for priority species (for example, Adopt a Rare plant and Rare Plant Monitoring Stewards Program supported by DBG, CNAP, CNHP & CoNPS) and provide results to appropriate land managers to facilitate adaptive management for the long-term survival of PGCN.
- Review existing monitoring studies for their adequacy in detecting trends, redesigning studies when warranted
- Ensure monitoring studies have adequate funding to address key questions in a scientifically rigorous manner, use consistent methodology, and effectively inform adaptive management.
- Devise a monitoring schedule to ensure that all PGCN populations are monitored at appropriate and cost effective intervals in order to quickly detect population declines and ensure occurrence persistence.
- Update Natural Heritage ranks and the Biodiversity Scorecard every five years to record changes in conservation status of rare plants.

Table 4. List of Plants of Greatest Conservation Need (PGCN) currently being monitored, with lead agency for monitoring efforts.

Species	Common Name	Agency or Organization Leads
<i>Aletes humilis</i>	Larimer aletes	TNC
<i>Astragalus debequaeus</i>	DeBeque milkvetch	BLM
<i>Astragalus microcymbus</i>	Skiff milkvetch	DBG, BLM
<i>Astragalus osterhoutii</i>	Kremmling milkvetch	BLM
<i>Astragalus schmolliae</i>	Chapin Mesa milkvetch	CNHP, MVNP
<i>Eriogonum brandegeei</i>	Brandegee's buckwheat	DBG, BLM
<i>Eriogonum pelinophilum</i>	Clay-loving wild buckwheat	BLM, CNAP
<i>Eutrema penlandii</i>	Penland alpine fen mustard	BLM, USFS, MRHI
<i>Ipomopsis polyantha</i>	Pagosa skyrocket	CNAP, BLM, FWS
<i>Mimulus gemmiparus</i>	Budding monkeyflower	CNAP
<i>Oenothera acutissima</i>	Narrow-leaf evening primrose	BLM
<i>Oenothera coloradensis</i> ssp. <i>coloradensis</i>	Colorado butterfly plant	CFC
<i>Penstemon debilis</i>	Parachute penstemon	BLM, CNAP, OXY USA
<i>Penstemon grahamii</i>	Graham's penstemon	BLM
<i>Penstemon penlandii</i>	Penland's penstemon	BLM
<i>Phacelia formosula</i>	North Park phacelia	BLM, ANWR
<i>Physaria bellii</i>	Bell's twinpod	CB, CNAP, DBG, CFC
<i>Physaria congesta</i>	Dudley Bluffs bladderpod	BLM, CNAP
<i>Physaria obcordata</i>	Piceance twinpod	BLM, CNAP
<i>Physaria pruinosa</i>	Frosty bladderpod	CNHP, TNC
<i>Ptilagrostis porteri</i>	Porter feathergrass	USFS
<i>Sclerocactus glaucus</i>	Colorado hookless cactus	DBG, BLM
<i>Spiranthes diluvialis</i>	Ute ladies'-tresses	CB, CFC

Key to agency acronyms

ANWR – Arapaho National Wildlife Refuge
 BLM – Bureau of Land Management
 CB – City of Boulder MRHI –
 CFC – City of Fort Collins
 CNAP – Colorado Natural Areas Program
 CNHP – Colorado Natural Heritage Program

DBG – Denver Botanical Gardens
 FWS – Fish & Wildlife Service
 Mosquito Range Heritage Initiative
 MVNP – Mesa Verde National Park
 TNC – The Nature Conservancy
 USFS – United States Forest Service

Success of Conservation Actions

Conserving Colorado's PGCN means that they are adequately protected, with low threats and high viability. Four fundamental questions over the long term are:

- *How are Colorado's PGCN doing?*
- *Do we understand the challenges to the status of these plants and how to address them?*
- *Are the conservation actions we are taking having the intended effects?*
- *Is there adequate capacity to achieve our goals?*

These four questions can be answered by various measures, including monitoring indicators that gauge the status of the PGCN and their primary threats. Tracking progress towards goals and evaluating the effectiveness of conservation actions will provide the feedback needed to adjust priorities and objectives. Measuring results provides the basis for adaptive management in this conservation approach.

A framework for measuring success of conservation actions is proposed below. These indicators should be measured or assessed every five years unless greater urgency is identified.

Viability Status

Viability status can be evaluated by monitoring various trends:

- Proportion of all PGCN species with good to excellent viability scores (measured by the proportion of A or B ranked occurrences of each species in CNHP's database).
- Proportion of all PGCN species with seed collections in ex situ storage.
- Field monitoring of PGCN species demonstrates stable to increasing trends across ten year time periods.

Threat Status

Threat status can be evaluated by various measures:

- Number of high priority threats per PGCN in the 2015 SWAP addendum vs the number in 5 years.
- Quantitative field monitoring of the disturbance effects of grazing, OHV travel, or energy development to PGCN. Stable population trends over 10 years are desirable.

Protection/Conservation Status

Protection and conservation status can be evaluated by measuring various indicators:

- Proportion of all Important Plant Areas with conservation action plans completed with local stakeholder involvement. Presently there are 16 IPAs managed within eight conservation action plans (CAPs) (see Appendix C).
- Proportion of Important Plant Areas with land trusts or agencies working on habitat conservation. For example, there are currently 39 IPAs with portions of their acreage protected by the Colorado Natural Areas Programs through voluntary conservation agreements with landowners (see Appendix C).
- Proportion of occurrences of PGCN with on-the-ground habitat protection (e.g., conservation easements, special designations such as Research Natural Area (RNA) or Area of Critical Environmental Concern (ACEC,) management agreements, etc.). There are currently 33 IPAs with portions of their acreage protected by an RNA or ACEC.
- Success in obtaining state legislation to conserve PGCN.
- Success in obtaining a long-term program and funding mechanism to support a rare plant conservation program in Colorado.

Part 7: REVIEW, COORDINATION, AND PUBLIC PARTICIPATION

Review and Updates to the Rare Plant SWAP

Review and updates to the rare plant SWAP follows the process outlined in the Colorado SWAP, Chapter 9 which states:

Guidance provided by USFWS and the AFWA Best Practices for State Wildlife Action Plans document for updating SWAPs distinguishes between major revisions and minor revisions. Major revisions include any change to the SGCN list or the threats assessment, or any change that could result in changes to conservation actions or their priority. We have generated our SGCN list and the subsequent analyses with an eye to potential changes in conservation issues over the next decade. Thus, we do not anticipate the need to conduct major revisions over the 10-year life of this plan. If that need were to occur, we would follow USFWS guidance in conducting major revisions. Meanwhile, as new information becomes available relative to required SWAP elements, it will be incorporated into the SWAP database for use in the next scheduled SWAP update.

Future revision of this Addendum will be subject to whatever process CPW ultimately employs in updating the State's SWAP. Coordination among conservation partners, agencies, and other interested parties for conservation of Colorado's rare plants will continue to be led by the RPCI.

Partner Coordination & Public Participation

Throughout the development of the 2011 Draft Rare Plant Addendum to the SWAP, the Rare Plant Conservation Initiative (RPCI) was the primary means of coordination with federal, state, and local agencies on the development and content of the draft document. The RPCI partners have been successful in working with Colorado Parks and Wildlife (CPW) to include rare plants in this iteration of the State's SWAP. For this 2015 revision, members of the RPCI once again provided the primary means of coordination. To augment the coordination and review provided by the RPCI, Parts 1-6 were also sent out for review to a list of stakeholders derived from the RPCI partnership and the membership of the Colorado Native Plant Society. These two groups represent over 700 individuals from all levels of government, as well as non-governmental organizations, the private sector, various interest groups, and private citizens. A complete list of the original 2011 RPCI partners can be found Appendix E.

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APPENDIX A: TAXONOMIES OF THREATS AND CONSERVATION ACTIONS FOR SPECIES AND HABITATS

Table A1. Threat taxonomy for species and habitats

Level 1	Level 2 (General Threats in Part 5, Table 3)	Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)
<p>1 Residential & Commercial Development</p> <p>Threats from human settlements or other non-agricultural land uses with a substantial footprint</p>	<p>1.1 Housing & Urban Areas</p> <p>Human cities, towns, and settlements including non-housing development typically integrated with housing (e.g., shopping areas, offices, schools, hospitals)</p>	<ul style="list-style-type: none"> Urban, suburban, and ex-urban development
	<p>1.2 Commercial & Industrial Areas</p> <p>Factories and other commercial centers (e.g., manufacturing plants, military bases, power plants, train yards, airports)</p>	<ul style="list-style-type: none"> Commercial and industrial development
	<p>1.3 Tourism & Recreation Areas</p> <p>Tourism and recreation sites with a substantial footprint (e.g., ski areas, golf courses, county parks, campgrounds)</p>	<ul style="list-style-type: none"> Recreation area developments
<p>2 Agriculture & Aquaculture</p> <p>Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture and aquaculture</p>	<p>2.1 Annual & Perennial Non-Timber Crops</p> <p>Crops planted for food, fodder, fiber, fuel, or other uses (e.g., farms, plantations, orchards, vineyards, mixed agroforestry systems)</p>	<ul style="list-style-type: none"> Conversion to cropland Intensive agricultural operations

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Level 1	Level 2 (General Threats in Part 5, Table 3)	Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)
	<p>2.2 Wood & Pulp Plantations</p> <p>Stands of trees planted for timber or fiber outside of natural forests, often with non-native species (e.g., silviculture, Christmas tree farms)</p>	
	<p>2.3 Livestock Farming & Ranching</p> <p>Domestic terrestrial animals raised in one location on farmed or non-local resources (farming); also domestic or semi-domesticated animals allowed to roam in the wild and supported by natural habitats (ranching) (e.g., cattle feed lots, dairy farms, cattle ranching, chicken farms)</p>	<ul style="list-style-type: none"> • Altered native vegetation • Degradation of alpine habitats from sheep grazing • Incompatible timing, intensity, duration of grazing • Range improvement operations • Reduced grass and forb diversity • Incompatible timing, intensity, duration of grazing
	<p>2.4 Marine & Freshwater Aquaculture</p> <p>Aquatic animals raised in one location on farmed or non-local resources; also hatchery fish allowed to roam in the wild</p>	
<p>3 Energy Production & Mining</p> <p>Threats from production of non-biological resources</p>	<p>3.1 Oil & Gas Drilling</p> <p>Exploring for, developing, and producing petroleum and other liquid hydrocarbons (e.g., oil wells, natural gas drilling)</p>	<ul style="list-style-type: none"> • Altered native vegetation • Fragmentation of native habitat due to oil/gas development & associated infrastructure
	<p>3.2 Mining & Quarrying</p> <p>Exploring for, developing, and producing minerals and rocks (e.g., coal mines, alluvial gold panning, gold mines, rock quarries)</p>	<ul style="list-style-type: none"> • Mining operations • Uranium mining

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Level 1	Level 2 (General Threats in Part 5, Table 3)	Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)
	<p>3.3 Renewable Energy</p> <p>Exploring, developing, and producing renewable energy (e.g., geothermal power production, solar farms, wind farms)</p>	<ul style="list-style-type: none"> • Fragmentation of native habitat due to renewable energy development & associated infrastructure
<p>4 Transportation & Service Corridors</p> <p>Threats from long narrow transport corridors and the vehicles that use them</p>	<p>4.1 Roads & Railroads</p> <p>Surface transport on roadways and dedicated tracks (e.g., highways, secondary roads, logging roads, bridges and causeways, fencing associated with roads, railroads)</p>	<ul style="list-style-type: none"> • Fragmentation • Right of Way maintenance
	<p>4.2 Utility & Service Lines</p> <p>Transport of energy & resources (e.g., electrical and phone wires, oil and gas pipelines)</p>	<ul style="list-style-type: none"> • Fragmentation • Right of Way maintenance • Habitat alteration
<p>5 Biological Resource Use</p> <p>Threats from consumptive use of “wild” biological resources including both deliberate and unintentional harvesting effects; also control of specific species</p>	<p>5.1 Control of Nuisance Species or Collecting¹</p> <p>Killing or control of non-native plant species</p>	<ul style="list-style-type: none"> • Herbicide treatment of non-native <i>Cirsium</i> species • Bio-control of non-native <i>Cirsium</i> species

¹ In the Salafsky taxonomy, this threat is “Hunting and Collecting Terrestrial Animals.” Salafsky’s terminology is intended to address conservation needs at a global scale, including places where hunting is not managed. For the purposes of Colorado’s Rare Plant SWAP, the reference to hunting in this context was deemed to be misleading and inappropriate. Thus, we have re-named this threat category.

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<p>Level 1</p>	<p>Level 2 (General Threats in Part 5, Table 3)</p>	<p>Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)</p>
	<p>5.2 Gathering Terrestrial Plants</p> <p>Harvesting plants, fungi, and other non-timber/non-animal products for commercial, recreation, subsistence, research or cultural purposes, or for control reasons (e.g., wild mushrooms, cactus, orchids, control of host plants to combat timber diseases)</p>	<ul style="list-style-type: none"> • Collection of orchids, cactus
	<p>5.3 Logging & Wood Harvesting</p> <p>Harvesting trees and other woody vegetation for timber, fiber, or fuel (e.g., clear cutting of hardwoods, pulp operations, fuel wood collection)</p>	<ul style="list-style-type: none"> • Clearcutting • Even-age timber management • Fragmentation
	<p>5.4 Fishing & Harvesting Aquatic Resources</p> <p>Harvesting aquatic wild animals or aquatic plants for commercial, recreation, subsistence, research, or cultural purposes, or for control/persecution reasons</p>	
<p>6 Human Intrusions & Disturbance</p> <p>Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources</p>	<p>6.1 Recreational Activities</p> <p>People spending time in nature or traveling in vehicles outside of established transport corridors, usually for recreational reasons (e.g., off-road vehicles, snowmobiles, mountain bikes, hikers, skiers, pets in rec areas, temporary campsites, rock-climbing)</p>	<ul style="list-style-type: none"> • Campsites and hiking • ORV trail development and use • Motorized and non-motorized recreation • Rock climbing, hiking near cliffs & crevices

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Level 1	Level 2 (General Threats in Part 5, Table 3)	Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)
	<p>6.2 War, Civil Unrest & Military Exercises</p> <p>Actions by military forces without a permanent footprint (e.g., tanks and other military vehicles, training exercises and ranges, defoliation, munitions testing)</p>	<ul style="list-style-type: none"> • Tank maneuver's
	<p>6.3 Work & Other Activities</p> <p>People spending time in or traveling in natural environments for reasons other than recreation, military activities, or research (e.g., law enforcement, drug smugglers, illegal immigrants, species research, vandalism)</p>	<ul style="list-style-type: none"> • Proximal non-recreation disturbance • Infrastructure development for recreational visitor use
<p>7 Natural System Modifications</p> <p>Threats from actions that convert or degrade habitat in service of “managing” natural or semi-natural systems, often to improve human welfare</p>	<p>7.1 Fire & Fire Suppression</p> <p>Suppression or increase in fire frequency and/or intensity outside of its natural range of variation (e.g., fire suppression to protect homes, inappropriate fire management, escaped agricultural fires, arson, campfires)</p>	<ul style="list-style-type: none"> • Altered fire regime • Fire suppression leading to high intensity fires • Altered fire regime and juniper encroachment • Wildfires exacerbated by climate change
	<p>7.2 Dams & Water Management/Use</p> <p>Changing water flow patterns from their natural range of variation either deliberately or as a result of other activities (e.g., dam construction, dam operations, sediment control, change in salt regime, wetland filling, levees and dikes, surface water diversion, groundwater pumping, channelization, artificial lakes)</p>	<ul style="list-style-type: none"> • Altered hydrological regime (surface or aquifer) • Natural system modification (hydrological) - dam, diversion, or drop structure construction or modification • Natural system modification (hydrological) – groundwater pumping and surface water diversions • Scouring floods • Water storage

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<p>Level 1</p>	<p>Level 2 (General Threats in Part 5, Table 3)</p>	<p>Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)</p>
	<p>7.3 Other Ecosystem Modifications</p> <p>Other actions that convert or degrade habitat in service of “managing” natural systems to improve human welfare (e.g., land reclamation projects, abandonment of managed lands, rip-rap along shorelines, mowing grass, tree thinning, removal of snags from streams)</p>	<ul style="list-style-type: none"> • Altered native vegetation • Fragmentation • Natural system modification - wetland filling, eutrophication, siltation
<p>8 Invasive & Other Problematic Species & Genes</p> <p>Threats from non-native and native plants, animals, pathogens /microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance</p>	<p>8.1 Invasive Non-Native/Alien Species</p> <p>Harmful plants, animals, and microbes not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities (e.g., feral animals, cheatgrass)</p>	<ul style="list-style-type: none"> • Invasive plants – tamarisk • Invasive plants – cheatgrass
	<p>8.2 Problematic Native Species</p> <p>Harmful plants, animals, or microbes that are originally found within the ecosystem(s) in question, but have become "out-of-balance" or "released" directly or indirectly due to human activities (e.g., native plants that hybridize with other plants)</p>	<ul style="list-style-type: none"> • Habitat loss / degradation due to beetle kill • Habitat loss due to insect damage and fire • Predation and parasites
	<p>8.3 Introduced Genetic Material</p> <p>Human altered or transported organisms or genes (e.g., pesticide resistant crops, using nonlocal seed stock, genetically modified insects for biocontrol)</p>	<ul style="list-style-type: none"> • Hybridization with nonlocal genetic material

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<p>Level 1</p>	<p>Level 2 (General Threats in Part 5, Table 3)</p>	<p>Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)</p>
	<p>8.4 Pathogens</p>	<ul style="list-style-type: none"> • NA
<p>9 Pollution Threats from introduction of exotic and/or excess materials or energy from point and nonpoint sources</p>	<p>9.1 Household Sewage & Urban Waste Water Water-borne sewage and non-point runoff from housing and urban areas that include nutrients, toxic chemicals and/or sediments (e.g., discharge from municipal waste treatment plants, leaking septic systems, fertilizers and pesticides from lawns and golf-courses)</p>	<ul style="list-style-type: none"> • Water pollution
	<p>9.2 Industrial & Military Effluents Water-borne pollutants from industrial and military sources including mining, energy production, and other resource extraction industries that include nutrients, toxic chemicals and/or sediments</p>	<ul style="list-style-type: none"> • Waste or residual materials (mine tailings, excess sediment loads, etc.)
	<p>9.3 Agricultural & Forestry Effluents Water-borne pollutants from agricultural, silvicultural, and aquaculture systems that include nutrients, toxic chemicals and/or sediments (e.g., nutrient loading from fertilizer runoff, herbicide runoff, manure from feedlots, soil erosion)</p>	<ul style="list-style-type: none"> • Herbicide/pesticide spraying or runoff and nonpoint source pollution • Nutrient loads • Pesticide spraying (prey reduction) • Poisoning (fire ant insecticides) • Reduced water quality due to herbicide/pesticide runoff
	<p>9.4 Garbage & Solid Waste Rubbish and other solid materials including those that entangle wildlife</p>	

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Level 1	Level 2 (General Threats in Part 5, Table 3)	Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)
	<p>9.5 Air-Borne Pollutants</p> <p>Atmospheric pollutants from point and nonpoint sources (e.g., acid rain, smog from vehicle emissions, excess nitrogen deposition)</p>	<ul style="list-style-type: none"> • Air pollution (precipitating/concentrating on high elevation snow fields)
	<p>9.6 Excess Energy</p> <p>Inputs of heat, sound, or light that disturb wildlife or ecosystems (e.g., noise from highways or airplanes, heated water from power plants, lamps attracting insects)</p>	
<p>10 Geological Events</p> <p>Threats from catastrophic geological events</p>	<p>10.1 Volcanoes <i>(not applicable to Colorado)</i></p> <p>Volcanic events (e.g., eruptions, emissions of volcanic gasses)</p>	
	<p>10.2 Earthquakes/Tsunamis <i>(not likely to be applicable to Colorado)</i></p> <p>Earthquakes and associated events</p>	
	<p>10.3 Avalanches/Landslides</p> <p>Avalanches or landslides</p>	
<p>11 Climate Change & Severe Weather</p> <p>Threats from long-term climatic changes which may be linked to global warming and other severe climatic/weather events that are outside of the natural range of variation, or potentially can wipe out a vulnerable species or habitat</p>	<p>11.1 Habitat Shifting & Alteration</p> <p>Major changes in habitat composition and location (e.g., desertification, tundra thawing)</p>	<ul style="list-style-type: none"> • Habitat shifting and alteration due to climate change • Phenological response to climate change of species itself and/or inter-dependent species unknown • Vulnerability due to movement barriers, poor dispersal capacity, and/or restriction to rare habitat features •

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Level 1	Level 2 (General Threats in Part 5, Table 3)	Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)
	<p>11.2 Droughts</p> <p>Periods in which rainfall falls below the normal range of variation (e.g., severe lack of rain, loss of surface water sources)</p>	<ul style="list-style-type: none"> Lack of water due to drought and exacerbated by climate change
	<p>11.3 Temperature Extremes</p> <p>Periods in which temperatures exceed or go below the normal range of variation (e.g., heat waves, cold spells, disappearance of glaciers)</p>	
	<p>11.4 Storms & Flooding</p> <p>Extreme precipitation and/or wind events (e.g., thunderstorms, tornados, hailstorms, ice storms or blizzards, dust storms)</p>	<ul style="list-style-type: none"> Climate variability (e.g., prolonged rain or hail events) Climate variability (intensification or alteration of normal weather patterns, e.g., droughts, tornados)
12 Organizational capacity and management*	12.1 Lack of coordination	
	12.2 Lack of funding	
	12.3 Lack of common goals	
	12.4 Confused or gaps in authorities	
	12.5 Legislation/policy changes	
13 Lack of knowledge*	13.1 Complete distribution in Colorado unknown	<ul style="list-style-type: none"> Complete distribution in Colorado unknown
	13.2 Critical life history/habitat components unknown	<ul style="list-style-type: none"> Biology, ecology, and habitat poorly known
	13.3 Genetic relationship with other species or subspecies unknown	<ul style="list-style-type: none"> Taxonomic status is uncertain

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Level 1	Level 2 (General Threats in Part 5, Table 3)	Level 3 – illustrative examples (Specific Threats in Part 5, Table 3)
	13.4 Population status unknown (majority of documented occurrences are ranked E or H)	<ul style="list-style-type: none"> Lack of data on population status
	13.5 Population trend unknown	<ul style="list-style-type: none"> Long term population trends unknown
	13.6 Response to change, disturbance, & other threats poorly understood	<ul style="list-style-type: none"> Threats are poorly understood Response to management/disturbance poorly understood
14 Natural Factors*	14.1 Scarcity (leading to inbreeding depression)	<ul style="list-style-type: none"> Globally rare and/or small population size
	14.2 Low annual recruitment	
	14.3 Low reproductive rate	
	14.4 Predation	<ul style="list-style-type: none"> Herbivory
	14.5 Competition	
	14.6 Loss of species from suitable habitat	

*These factors are not included in Salafsky et al. 2008, but were deemed necessary to fully express threats to wildlife in Colorado.

Table A2. Conservation Action taxonomy for PGCN species and habitats

Level 1	Level2 (General Actions in Part 5, Table 3)	Level 3 (Specific Actions in Part 5, Table 3)
<p>1 Land/Water Protection</p> <p>Actions to identify, establish or expand parks and other legally protected areas</p>	<p>1.1 Site/Area Protection</p> <p>Establishing or expanding public or private parks, reserves, and other protected areas (e.g., national parks, wildlife sanctuaries, private reserves)</p>	<ul style="list-style-type: none"> • Purchase or acquire legal ownership of land for protection of species or habitat
	<p>1.2 Resource & Habitat Protection</p> <p>Establishing protection or easements of some specific aspect of the resource on public or private lands (e.g., easements, development rights, water rights, instream flow rights, wild and scenic river designation)</p>	<ul style="list-style-type: none"> • Acquire conservation easement for habitat protection • Acquire water rights or instream flow rights • Establish and/or expand legal designation to protect habitat (e.g., wilderness, state Natural Area, Research Natural Area, Area of Critical Environmental Concern)
<p>2 Land/Water Management</p> <p>Actions directed at conserving or restoring sites, habitats and the wider environment</p>	<p>2.1 Site/Area Management</p> <p>Management of protected areas and other resource lands for conservation (e.g., site design, demarcating borders, putting up fences, training park staff, control of poachers)</p>	<ul style="list-style-type: none"> • Design public improvements to be compatible with biodiversity • Implement compatible practices for transportation projects • Implement compatible forest management • Implement compatible grazing practices • Implement seasonal closures • Manage public use to be compatible with biodiversity • Manage to limit disturbance

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<p>Level 1</p>	<p>Level 2 (General Actions in Part 5, Table 3)</p>	<p>Level 3 (Specific Actions in Part 5, Table 3)</p>
	<p>2.2 Invasive/Problematic Species Control</p> <p>Controlling and/or preventing invasive and/or other problematic plants, animals, and pathogens</p>	<ul style="list-style-type: none"> • Control non-native plants • Map weed infestations and sensitive no spray/no mow zones • Manage research, management, and recreation activities to control the spread of pathogens • Remove tamarisk through biological, chemical, mechanical means and prevent re-establishment • Write and/or implement integrated weed/pest management plan
	<p>2.3 Habitat & Natural Process Restoration</p> <p>Enhancing degraded or restoring missing habitats and ecosystem functions; dealing with pollution (e.g., creating forest corridors, prairie re-creation, riparian tree plantings, prescribed burns, breaching levees, dam removal)</p>	<ul style="list-style-type: none"> • Adjust operation of dam • Discourage introduction of non-native ornamental species • Maintain appropriate patch size and habitat mosaic • Manage natural herbivory • Remove infrastructure (e.g., roads, dams) • Re-seed native species • Restore and/or close overused trails, tracks • Restore native habitat • Restore natural fire regime • Restore natural hydrologic regime

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<p>Level 1</p>	<p>Level 2 (General Actions in Part 5, Table 3)</p>	<p>Level 3 (Specific Actions in Part 5, Table 3)</p>
<p>3 Species Management</p> <p>Actions directed at managing or restoring species, focused on the species of concern itself</p>	<p>3.1 Species Management</p> <p>Managing specific plant populations of concern</p>	<ul style="list-style-type: none"> • Develop collaborative management agreements • Model potential habitat/range shifts in response to projected climate changes and prepare adaptation plan to define in situ and ex situ conservation needs • Implement existing management/recovery plan • Maintain comprehensive species database • Write and implement management/recovery plan
	<p>3.2 Species Recovery</p> <p>Manipulating, enhancing or restoring specific plant and animal populations (e.g., manual pollination of trees, disease/parasite management)</p>	<ul style="list-style-type: none"> • Maintain genetic connection/integrity within and between populations
	<p>3.3 Species Re-Introduction</p> <p>Re-introducing species to places where they formally occurred or benign introductions</p>	<ul style="list-style-type: none"> • Reintroduce extirpated native species • Translocate species to historic range
	<p>3.4 Ex-Situ Conservation</p> <p>Protecting biodiversity out of its native habitats (e.g., captive breeding, artificial propagation, gene banking)</p>	<ul style="list-style-type: none"> • Seed banking (incl. protocols, collection, and cultivation)
<p>4 Education & Awareness</p> <p>Actions directed at people to improve understanding and skills, and influence behavior</p>	<p>4.1 Formal Education</p> <p>Enhancing knowledge and skills of students in a formal degree program (e.g., public schools, colleges, and universities, continuing education)</p>	

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<p>Level 1</p>	<p>Level 2 (General Actions in Part 5, Table 3)</p>	<p>Level 3 (Specific Actions in Part 5, Table 3)</p>
	<p>4.2 Training</p> <p>Enhancing knowledge, skills and information exchange for practitioners, stakeholders, and other relevant individuals in structured settings outside of degree programs (e.g., monitoring workshops or training, learning networks or how-to manuals, stakeholder education on specific issues)</p>	<ul style="list-style-type: none"> • Educate development industries about avoiding and/or mitigating rare plant impacts • Improve communication among researchers and policy/decision-makers • Improve knowledge of species, habitats, problems, via professional meetings and other venues
	<p>4.3 Awareness & Communications</p> <p>Raising environmental awareness and providing information through various media</p>	<ul style="list-style-type: none"> • Implement landowner outreach/education and incentives programs • Publish educational material/sponsor educational programs to raise public awareness
<p>5 Law & Policy</p> <p>Actions to develop, change, influence, and help implement formal legislation, regulations, and voluntary standards</p>	<p>5.1 Legislation</p> <p>Making, implementing, changing, influencing, or providing input into formal government sector legislation or policies (e.g., state ballot initiatives, providing data to policy makers, zoning regulations, species protection laws)</p>	

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<p>Level 1</p>	<p>Level 2 (General Actions in Part 5, Table 3)</p>	<p>Level 3 (Specific Actions in Part 5, Table 3)</p>
	<p>5.2 Policies & Regulations</p> <p>Making, implementing, changing, influencing, or providing input into policies and regulations affecting the implementation of laws at all levels: international, national, state/provincial, local/community, tribal (e.g., input into agency plans regulating certain species or resources, working with local governments or communities to implement zoning regulations, promoting sustainable harvest on state lands)</p>	<ul style="list-style-type: none"> • Establish mitigation requirements for developments • Promote consideration of biodiversity issues in transportation and land use planning processes • Promote zoning that concentrates use and protects habitat • Work with state and federal partners to limit density of oil/gas leasing and development
	<p>5.3 Private Sector Standards & Codes</p> <p>Setting, implementing, changing, influencing, or providing input into voluntary standards & professional codes that govern private sector practice (e.g., Conservation Measures Partnership Open Standards, corporate adoption of forestry best management practices, sustainable grazing by a rancher)</p>	<ul style="list-style-type: none"> • Implement Best Management Practices for <ul style="list-style-type: none"> ○ Recreation management ○ energy development & mining ○ forest management ○ livestock grazing ○ transportation, urban development, landscaping ○ water resource management
	<p>5.4 Compliance & Enforcement</p> <p>Monitoring and enforcing compliance with laws, policies & regulations, and standards & codes at all levels (e.g., water quality standard monitoring, initiating criminal and civil litigation)</p>	<ul style="list-style-type: none"> • Enforce 404 wetlands regulations • Enforce collecting regulations • Enforce state/federal/local pollution standards • Enforce off-road travel restrictions

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<p>Level 1</p>	<p>Level2 (General Actions in Part 5, Table 3)</p>	<p>Level 3 (Specific Actions in Part 5, Table 3)</p>
<p>6 Livelihood, Economic & Other Incentives</p> <p>Actions to use economic and other incentives to influence behavior</p>	<p>6.1 Linked Enterprises & Livelihood Alternatives</p> <p>Developing enterprises that directly depend on the maintenance of natural resources or provide substitute livelihoods as a means of changing behaviors and attitudes (e.g., ecotourism, nontimber forest product harvesting)</p>	
	<p>6.2 Substitution</p> <p>Promoting alternative products and services that substitute for environmentally damaging ones (e.g., farmed salmon as a replacement for pressure on wild populations, promoting recycling and use of recycled materials)</p>	
	<p>6.3 Market Forces</p> <p>Using market mechanisms to change behaviors and attitudes (e.g., certification, positive incentives, grass and forest banking, valuation of ecosystem services such as flood control)</p>	
	<p>6.4 Conservation Payments</p> <p>Using direct or indirect payments to change behaviors and attitudes (e.g., quid-pro-quo performance payments, resource tenure incentives)</p>	<ul style="list-style-type: none"> • Implement Purchase/Transfer Development Rights program for habitat protection • Mitigate species/habitat loss (e.g., grass banking, mitigation banking, credits for off-site habitat protection)

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<p>Level 1</p>	<p>Level 2 (General Actions in Part 5, Table 3)</p>	<p>Level 3 (Specific Actions in Part 5, Table 3)</p>
	<p>6.5 Non-Monetary Values</p> <p>Using intangible values to change behaviors and attitudes (e.g., spiritual, cultural, links to human health)</p>	
<p>7 External Capacity Building</p> <p>Actions to build the infrastructure to do better conservation</p>	<p>7.1 Institutional & Civil Society Development</p> <p>Creating or providing non-financial support & capacity building for non-profits, government agencies, communities, and for-profits (e.g., creating new local land trusts)</p>	
	<p>7.2 Alliance & Partnership Development</p> <p>Forming and facilitating partnerships, alliances, and networks of organizations (e.g., Conservation Measures Partnership)</p>	<ul style="list-style-type: none"> • Coordinate with related agencies to align goals, policies, measures of success, etc. • Coordinate with related agencies to identify and secure funding • Engage in collaborative, proactive planning and conservation programs
	<p>7.3 Conservation Finance</p> <p>Raising and providing funds for conservation work (private foundations, debt-for-nature swaps)</p>	<ul style="list-style-type: none"> • Provide economic assistance for private land habitat improvements and/or species conservation • Obtain funding to support recommended conservation actions

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<p>Level 1</p>	<p>Level2 (General Actions in Part 5, Table 3)</p>	<p>Level 3 (Specific Actions in Part 5, Table 3)</p>
<p>8 Research and Monitoring* (general actions in Table X)</p>		<ul style="list-style-type: none"> • Conduct field inventory to refine known distribution • Conduct primary research on species and habitat responses to changing climate • Improve understanding of species/habitat distribution (field inventory, modeling) • Research critical life history/habitat components • Research population parameters and/or monitor status. • Research species/habitat response to management • Research genetic relation to other (sub)species

* This factor is not included in the Salafsky classification, but was deemed necessary to fully express actions needed to conserve wildlife and rare plants in Colorado.

APPENDIX B: CLIMATE CHANGE VULNERABILITY INDEX (CCVI)

The CCVI uses a scoring system that integrates a species' predicted exposure to climate change within an assessment area and three sets of factors associated with climate change sensitivity, each supported by published studies: 1) indirect exposure to climate change, 2) species-specific factors (including dispersal ability, temperature and precipitation sensitivity, physical habitat specificity, interspecific interactions, and genetic factors), and 3) documented response to climate change (when available). The Index is a Microsoft Excel-based tool that facilitates a fairly rapid assessment of the vulnerability of a species to climate change within a defined geographic study area, and highlights the relative importance of factors contributing to that vulnerability.

The Index divides vulnerability into two components: 1) the **exposure** to climate change across the range of the species within the assessment area, and 2) the **sensitivity** of the species to climate change. A highly sensitive species will not suffer if the climate where it occurs remains stable. Similarly, an adaptable species would presumably not decline even in the face of significant changes in temperature and/or precipitation. Exposure to climate change is measured by examining the magnitude of predicted temperature and moisture change across the range of the species within the assessment area. In this analysis, exposure was calculated in GIS using data from the Climate Wizard (<http://climatewizard.org>). In the Index, sensitivity is assessed by scoring species against 20 factors of indirect exposure to climate change and species-specific sensitivity. For each factor, species were scored on a sliding scale from greatly increasing, to having no effect on, to decreasing vulnerability. The six possible scores are Extremely Vulnerable, Highly Vulnerable, Moderately Vulnerable, Not Vulnerable/Presumed Stable, Not Vulnerable/Increase Likely, and Insufficient Evidence.

Scoring Category Definitions and Assumptions Used in Completing CCVIs for Colorado Plants of Greatest Conservation Need

OVER-ARCHING ASSUMPTION: Favorable conditions will generally shift northward in latitude and upward in elevation. It is possible that species that are closely associated with micro-climate conditions will not necessarily follow this rule. However, for the purposes and scale of this rapid assessment, spatially explicit micro-climate conditions were not considered.

Section A – Exposure to Local Climate Change

Temperature: percent of species known range/distribution that is expected to experience temperature increase, in categories defined by the CCVI. All of Colorado falls within the top 2 categories: >5 degrees warmer and 5.1-5.5 degrees warmer. This was a GIS calculation using CNHP Element Occurrence Records and the ensemble average climate model from Climate Wizard, with the medium emissions scenario. Analysis period was to 2050.

AET:PET Moisture Metric: This index integrates projected temperature and precipitation changes to indicate how much drying will take place. This metric was created by NatureServe as part of the CCVI. We used a GIS calculation to determine the percent of each species' range/distribution (represented by EORs) that fall within each rating category. Categories are:

< -0.119
-0.097 - -0.119
-0.074 - -0.096
-0.051 - -0.073
-0.028 - -0.050
>-0.028

Section B – Indirect Exposure to Climate Change

1. **Exposure to sea level rise:** not applicable to Colorado. We rated all species 'Neutral.'
- 2a. **Distribution relative to natural barriers:** degree to which species' vulnerability is influenced by its ability to shift range/distribution in response to climate change. Scoring categories *for both natural barriers and anthropogenic barriers* are:

<i>Greatly Increase Vulnerability:</i>	Barriers completely OR almost completely surround the current distribution such that the species' range in the assessment area is unlikely to be able to shift significantly with climate change, or the direction of climate change-caused shift in the species' favorable climate envelope is fairly well understood and barriers prevent a range shift in that direction. See <i>Neutral</i> for species in habitats not vulnerable to climate change.
	<i>Examples for natural barriers:</i> lowland terrestrial species completely surrounded by high mountains (or bordered closely and completely on the north side by high mountains); cool-water stream fishes for which barriers would completely prevent access to other cool-water areas if the present occupied habitat became too warm as a result of climate change; most nonvolant species that exist only on the south side of a very large lake in an area where habitats are expected to shift northward with foreseeable climate change.

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	<p><i>Examples for anthropogenic barriers:</i> species limited to small habitats within intensively developed urban or agricultural landscapes through which the species cannot pass, A specific example of this category is provided by the quino checkerspot butterfly (<i>Euphydryas editha quino</i>), a resident of northern Baja California and southern California; warming climates are forcing this butterfly northward, but urbanization in San Diego blocks its movement (Parmesan 1996, Nature 382:765).</p>
<p><i>Increase Vulnerability:</i></p>	<p>Barriers border the current distribution such that climate change-caused distributional shifts in the assessment area are likely to be greatly but not completely or almost completely impaired.</p>
	<p><i>Examples for natural barriers:</i> certain lowland plant or small mammal species whose ranges are mostly (50-90%) bordered by high mountains or a large lake.</p>
	<p><i>Examples for anthropogenic barriers:</i> most streams inhabited by a fish species have dams that would prevent access to suitable habitat if the present occupied habitat became too warm as a result of climate change; intensive urbanization surrounds 75% of the range of a salamander species.</p>
<p><i>Somewhat Increase Vulnerability:</i></p>	<p>Barriers border the current distribution such that climate change-caused distributional shifts in the assessment area are likely to be significantly but not greatly or completely impaired.</p>
	<p><i>Examples for natural barriers:</i> certain lowland plant or small mammal species whose ranges are partially but not mostly bordered by high mountains or a large lake.</p>
	<p><i>Examples for anthropogenic barriers:</i> 10-50% of the margin of a plant species' range is bordered by intensive urban development; 25% of the streams occupied by a fish species include dams that are likely to impede range shifts driven by climate change.</p>
<p><i>Neutral:</i></p>	<p>Significant barriers do not exist for this species, OR small barriers exist in the assessment area but likely would not significantly impair distributional shifts with climate change, OR substantial barriers exist but are not likely to contribute significantly to a reduction or loss of the species' habitat or area of occupancy with projected climate change in the assessment area.</p>
	<p><i>Examples of species in this category:</i> most birds (for which barriers do not exist); terrestrial snakes in extensive plains or deserts that may have small barriers that would not impede distributional shifts with climate change; small alpine-subalpine mammal (e.g., ermine, snowshoe hare) in extensive mountainous wilderness area lacking major rivers or lakes; fishes in large deep lakes or large main-stem rivers that are basically invulnerable to projected climate change and lack dams, waterfalls, and significant pollution; a plant whose climate envelope is shifting northward and range is bordered on the west by a barrier but for which no barriers exist to the north.</p>

We rated all species tied to specific substrates (i.e., barrens and cliff/canyon species) 'Increase' since the edge of these substrates will function as a barrier to plant movement. We rated all alpine species that

occur below 12,500 feet (i.e., could still shift upward in elevation) 'Increase' and all alpine species that only occur above 12,500 feet 'Greatly Increase.' All other species were evaluated individually based on spatial relationship (viewed in GIS) among known EOs, extent of modeled range/habitat (described below), and natural barriers (e.g., edge of habitat; surrounding mountains, canyons).

Previously developed models were available for: *Astragalus anisus*, *Astragalus debequaeus*, *Astragalus humillimus*, *Astragalus tortipes*, *Lesquerella congesta*, *Nuttallia chrysantha*, *Oenothera harringtonii*, *Oonopsis puebloensis*, *Oxybaphus rotundifolius*, *Penstemon grahamii*, *Phacelia submutica*, *Physaria obcordata*, and *Sclerocactus mesa-verdae*. For other species, we developed models using minimum convex polygons (defined by EORs and buffered by 50% of the polygon area) and SWReGAP vegetation. Vegetation types that intersected with EORs and overlapped the buffered minimum convex polygons were selected; all others were filtered out. Models were further constrained by elevation (defined in GIS by EOR distribution, and buffered on maximum and minimum ends by 10% of the elevation range). For barrens species, models were also constrained by SWReGAP geology. Geological types that overlapped EORs and overlapped the buffered minimum convex polygons were selected; all others were filtered out.

2b. Distribution relative to anthropogenic barriers: We rated all species individually based on the spatial relationship among known EOs, extent of modeled range/potential habitat (described above), and non-natural barriers (e.g., urban development, cropland). The natural and non-natural land cover used in this analysis was developed by reclassifying SWReGAP land cover categories. Definitions of scoring categories are listed above.

3. Impact of land use changes resulting from human responses to climate change: This factor is intended to identify species that might be further threatened by strategies designed to mitigate or adapt to climate change (e.g., renewable energy projects such as wind-farms, solar arrays, biofuels production, hydro-power; tree-planting for carbon offsets). We made the assumptions that:

- Tree planting for carbon offsets is not likely in Colorado;
- Wind development is most likely to occur on the eastern plains and Front Range;
- Solar array development is potential for any grassland or shrubland habitat on both east and west slopes;
- Significant hydro-power development is not likely in Colorado;
- Natural gas drilling should be included here based on on-going political "clean fuel" dialogue, and the assumption that natural gas drilling could increase because of this.

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Definitions of scoring categories are:

<p><i>Increase Vulnerability:</i></p>	<p>The natural history/requirements of the species are known to be incompatible with mitigation-related land use changes that are likely to very likely to occur within its current and/or potential future range. This includes (but is not limited to) the following:</p> <ul style="list-style-type: none"> ✓ Species requiring open habitats within landscapes likely to be reforested or afforested. If the species requires openings within forests that are created/maintained by natural processes (e.g., fire), and if those processes have a reasonable likelihood of continuing to operate within its range, a lesser impact category may be appropriate. ✓ Bird and bat species whose migratory routes, foraging territory, or lekking sites include existing and/or suitable wind farm sites. If numerous wind farms already exist along the species' migratory route, negative impacts have been found in relevant studies; if such studies exist but negative impacts have not been found, a lesser impact category may be appropriate. ✓ Greater than 20% of the species' range within the assessment area occurs on marginal agricultural land, such as CRP land or other open areas with suitable soils for agriculture ("prime farmland", etc.) that are not currently in agricultural production OR > 50% of the species' range within the assessment area occurs on any non-urbanized land with suitable soils, where there is a reasonable expectation that such land may be converted to biofuel production. ✓ The species occurs in one or more river/stream reaches not yet developed for hydropower, but with the potential to be so developed. ✓ Species of deserts or other permanently open, flat lands with potential for placement of solar arrays. ✓ Species dependent on dynamic shoreline habitats (e.g., active dunes or salt marshes) likely to be destroyed by human fortifications against rising sea levels.
<p><i>Somewhat Increase Vulnerability:</i></p>	<p>The natural history/requirements of the species are known to be incompatible with mitigation-related land use changes that <i>may possibly</i> occur within its current and/or potential future range, including any of the above (under Increase).</p>
<p><i>Neutral:</i></p>	<p>The species is unlikely to be significantly affected by mitigation-related land use changes that may occur within its current and/or potential future range, including any of the above; OR it is unlikely that any mitigation-related land use changes will occur within the species' current and/or potential future range.</p>

<p><i>Somewhat Decrease Vulnerability:</i></p>	<p>The species is likely to benefit from mitigation-related land use changes that may occur within its current and/or potential future range. This includes (but is not limited to) the following:</p> <ul style="list-style-type: none"> ✓ Forest-associated species currently found within a landscape with < 40% forest cover, where increases in forest cover may occur as a result of reforestation or afforestation projects. ✓ Species currently subject to a higher frequency of fires than experienced historically, where there may now be greater incentive to control such fires. ✓ Species occurring on unprotected lands which may be protected and managed for conservation due to their carbon storage and/or sequestration ability.
<p><i>Decrease Vulnerability:</i></p>	<p>The species is likely to benefit from mitigation-related land use changes that are likely to very likely to occur within its current and/or potential future range, including any of the above (under Somewhat Decrease).</p>

We rated species that occupy primarily barrens and grasslands ‘Increase’ or ‘Somewhat Increase’ based on the potential for wind, solar, and biofuels. One exception to this is *Corispermum navicula*, which we rated ‘Neutral’ based on the assumption that these resources would not likely be developed in sand dune habitats. We rated shrubland species ‘Increase’ based on the potential for wind and solar, with the exception of *Eriogonum brandegeei*, which occurs on erodible, steep slopes that are not as likely to be developed for these resources. Species listed in the RPCI strategy as being particularly threatened by oil and gas development were rated ‘Increase’ based on potential for natural gas. Alpine species, wetland species, and cliff/canyon species that are restricted to seeps were rated ‘Neutral’ based on assumption that these habitat types would be less likely to be developed in most mitigation scenarios. One exception to this general assumption is *Cleome multicaulis*, which we rated ‘Increase’ based on the potential for solar thermal plants in adjacent habitat, which could alter local hydrologic regimes. We rated forest species ‘Somewhat Decrease’ based on the assumption that forest management may be improved in the future in the interest of carbon sequestration. However, we rated most pinyon-juniper species ‘Neutral’ based on the assumption that the PJ woodlands would have less carbon value than montane/subalpine forests. Exceptions to this assumption were for *Astragalus debequaeus*, *Astragalus equisolensis*, *Lupinus crassus*, and *Penstemon fremontii* var. *glabrescens* which also occur in habitats with natural gas development.

Section C - Sensitivity

1. **Dispersal and movement:** *Mimulus gemmiparus* was rated ‘Greatly Increase’ because it propagates vegetatively within a very narrowly distributed habitat. *Botrychium lineare* was rated ‘Increase.’ According to Beatty et al. (2003), dispersal of *Botrychium lineare* spores probably occurs over short distances via gravity. They suggested that though spores may also travel long distances via wind, effective

long-distance dispersal would require specific conditions and isolation, fragmentation, and small population size are likely still important dispersal factors. *Eriogonum pelinophilum* was rated 'Increase' based on the fact that nearly all known plants are older, the species apparently reproduces infrequently, and most seedlings do not survive (P. Lyon, pers. comm.). This rating was extrapolated to *E. clavellatum*, since it is similar in this respect. The remaining *Eriogonum* species were given a split rating of 'Somewhat Increase' and 'Neutral' based on U.S. Forest Service species assessment for *E. coloradense* (Anderson 2004), which indicated potential for effective dispersal by animals, water and wind. This information was extrapolated to *E. brandegeei*, as it is similar in this respect. *Nuttallia chrysantha* was rated 'Somewhat Increase' based on potential for dispersal by animals and wind, but limited long-term seed viability (Anderson 2006). *Asclepias uncialis* ssp. *uncialis* and *Erigeron kachinensis* were also rated "Somewhat Increase' based on their potential for wind dispersal. *Ptilagrostis porteri*, *Puccinellia parishii*, and *Cirsium perplexans* were rated 'Neutral' based on their ability to efficiently disperse via wind. All other species were rated 'Increase' due to the fact that they reproduce primarily by seeds that fall close to the parent plant.

Definitions of scoring categories are:

<p><i>Greatly Increase Vulnerability:</i></p>	<p>Species is characterized by severely restricted dispersal or movement capability. This category includes species represented by sessile organisms that almost never disperse more than a few meters per dispersal event. Examples include: plants with large or heavy propagules for which the disperser is extinct or so rare as to be ineffective; species with dispersal limited to vegetative shoots, buds, or similar structures that do not survive (at least initially) if detached from the parent.</p>
<p><i>Increase Vulnerability:</i></p>	<p>Species is characterized by highly restricted dispersal or movement capability. This category includes species that rarely disperse through unsuitable habitat more than about 10 meters per dispersal event, and species in which dispersal beyond a very limited distance (or outside a small isolated patch of suitable habitat) periodically or irregularly occurs but is dependent on highly fortuitous or rare events. Examples include: plants dispersed ballistically; plant or animal species with free-living propagules or individuals that may be carried more than 10 meters by a tornado or unusually strong hurricane or large flood but that otherwise rarely disperse more than 10 meters; plants that do not fit criteria for Greatly Increase but lack obvious dispersal adaptations (i.e., propagules lack any known method for moving more than 10 meters away from the source plant).</p>

<p><i>Somewhat Increase Vulnerability:</i></p>	<p>Species is characterized by limited but not severely or highly restricted dispersal or movement capability. A significant percentage (at least approximately 5%) of propagules or individuals disperse approximately 10-100 meters per dispersal event (rarely farther), or dispersal capability likely is consistent with one of the following examples. Examples include; species that exist in small isolated patches of suitable habitat but regularly disperse or move among patches that are up to 100 meters (rarely farther) apart; many ant-dispersed plant species; plants whose propagules are dispersed primarily by small animals (e.g., some rodents) that typically move propagules approximately 10-100 meters from the source (propagules may be cached or transported incidentally on fur or feathers); plants dispersed by wind with low efficiency (e.g., species with inefficiently plumed seeds and/or that occur predominantly in forests).</p>
<p><i>Neutral:</i></p>	<p>Species is characterized by moderate dispersal or movement capability. A significant percentage (at least approximately 5%) of propagules or individuals disperse approximately 100-1,000 meters per dispersal event (rarely farther), or dispersal capability likely is consistent with one of the following examples. Examples include: species whose individuals exist in small isolated patches of suitable habitat but regularly disperse or move among patches that are 100-1,000 meters (rarely farther) apart; many plant species dispersed by wind with high efficiency (e.g., species with efficiently plumed seeds or very small propagules that occur predominantly in open areas); plant and animal species whose propagules or individuals are dispersed by small animals (e.g., rodents, grouse) that regularly but perhaps infrequently move propagules approximately 100-1,000 meters from the source).</p>
<p><i>Somewhat Decrease Vulnerability:</i></p>	<p>Species is characterized by good dispersal or movement capability. Species has propagules or dispersing individuals that readily move 1-10 kilometers from natal or source areas (rarely farther), or dispersal capability likely is consistent with one of the following examples. Examples include: plant species regularly dispersed up to 10 km (rarely farther) by large or mobile animals (e.g., plant has seeds that are cached, regurgitated, or defecated 1-10 kilometers from the source by birds [e.g., corvids, songbirds that eat small fleshy fruits] or mammals or that are transported on fur of large mobile animals such as most Carnivora or ungulates).</p>
<p><i>Decrease Vulnerability:</i></p>	<p>Species is characterized by excellent dispersal or movement capability. Species has propagules or dispersing individuals that readily move more than 10 kilometers from natal or source areas, or dispersal capability likely is consistent with one of the following examples.</p> <p>Examples include: plant or animal species whose individuals often or regularly are dispersed more than 10 kilometers by migratory or otherwise highly mobile animals, air or ocean currents, or humans, including species that readily become established outside their native ranges as a result of intentional or unintentional translocations by humans.</p>

2. **Sensitivity to temperature and moisture changes:** This factor pertains to the breadth of temperature and precipitation conditions, at both broad and local scales, within which a species is known to be capable

of reproducing, growing, or otherwise existing. Species with narrow environmental tolerances/requirements may be more vulnerable to habitat loss from climate change than are species that thrive under diverse conditions.

(a.i.) **historical thermal niche:** This factor measures large-scale temperature variation that a species has experienced in recent historical times (i.e., the past 50 years), as approximated by mean seasonal temperature variation (difference between highest mean monthly maximum temperature and lowest mean monthly minimum temperature). It is a proxy for species' temperature tolerance at a broad scale. This factor was calculated in GIS by assessing the relationship between EORs and historical temperature variation data downloaded from NatureServe.

Definitions of scoring categories are:

<i>Greatly Increase Vulnerability:</i>	Considering the mean seasonal temperature variation for occupied cells, the species has experienced very small (< 37° F/20.8° C) temperature variation in the past 50 years. Includes cave obligates and species occurring in thermally stable groundwater habitats.
<i>Increase Vulnerability:</i>	Considering the mean seasonal temperature variation for occupied cells, the species has experienced small (37 - 47° F/20.8 - 26.3° C) temperature variation in the past 50 years.
<i>Somewhat Increase Vulnerability:</i>	Considering the mean seasonal temperature variation for occupied cells, the species has experienced slightly lower than average (47.1 - 57° F/26.3 - 31.8° C) temperature variation in the past 50 years.
<i>Neutral:</i>	Considering the mean seasonal temperature variation for occupied cells, the species has experienced average (57.1 - 77° F/31.8 - 44.0° C) temperature variation in the past 50 years.
<i>Somewhat Decrease Vulnerability:</i>	Considering the mean seasonal temperature variation for occupied cells, the species has experienced greater than average (> 77° F/43.0° C) temperature variation in the past 50 years.

(a.ii.) **physiological thermal niche:** This factor assesses the degree to which a species is restricted to relatively cool or cold environments that are thought to be vulnerable to loss or significant reduction as a result of climate change. Alpine and cliff/canyon species were rated 'Increase' based on the assumption that these habitats are likely to be reduced as Colorado becomes warmer, and presumably drier. 'Somewhat increase' All others were rated 'Neutral' or 'Somewhat increase' based on species habitat preferences. Definitions of scoring categories are:

<i>Greatly Increase Vulnerability:</i>	Species is completely or almost completely (> 90% of occurrences or range) restricted to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.
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<i>Increase Vulnerability:</i>	Species is moderately (50-90% of occurrences or range) restricted to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.
<i>Somewhat Increase Vulnerability:</i>	Species is somewhat (10-50% of occurrences or range) restricted to relatively cool or cold environments that may be lost or reduced in the assessment area as a result of climate change.
<i>Neutral:</i>	Species distribution is not significantly affected by thermal characteristics of the environment in the assessment area, or species occupies habitats that are thought to be not vulnerable to projected climate change.
<i>Somewhat Decrease Vulnerability:</i>	Species shows a preference for environments toward the warmer end of the spectrum.

(b.i.) **historical hydrological niche:** This factor measures large-scale precipitation variation that a species has experienced in recent historical times (i.e., the past 50 years), as approximated by mean annual precipitation variation across occupied cells within the assessment area. Ratings for this factor were calculated in GIS by overlaying the species' Element Occurrence Records on mean annual precipitation data (1951-2006) from Climate Wizard, and subtracting the lowest pixel value from the highest value.

Definitions of scoring categories are:

<i>Greatly Increase Vulnerability:</i>	Considering the range of mean annual precipitation across occupied cells, the species has experienced very small (< 4 inches/100 mm) precipitation variation in the past 50 years.
<i>Increase Vulnerability:</i>	Considering the range of mean annual precipitation across occupied cells, the species has experienced small (4 - 10 inches/100 - 254 mm) precipitation variation in the past 50 years.
<i>Somewhat Increase Vulnerability:</i>	Considering the range of mean annual precipitation across occupied cells, the species has experienced slightly lower than average (11 - 20 inches/255 - 508 mm) precipitation variation in the past 50 years.
<i>Neutral:</i>	Considering the range of mean annual precipitation across occupied cells, the species has experienced average (21 - 40 inches/509 - 1,016 mm) precipitation variation in the past 50 years.
<i>Somewhat Decrease Vulnerability:</i>	Considering the range of mean annual precipitation across occupied cells, the species has experienced greater than average (> 40 inches/1,016 mm) precipitation variation in the past 50 years.

(b.ii.) **physiological hydrological niche:** This factor pertains to a species' dependence on a narrowly defined precipitation/hydrologic regime, including strongly seasonal precipitation patterns and/or specific aquatic/wetland habitats (e.g., certain springs, vernal pools, seeps, seasonal standing or flowing water) or localized moisture conditions that may be highly vulnerable to loss or reduction with climate change.

Definitions of scoring categories are:

<p><i>Greatly Increase Vulnerability:</i></p>	<p>Completely or almost completely (>90% of occurrences or range) dependent on a specific aquatic/wetland habitat or localized moisture regime that is highly vulnerable to loss or reduction with climate change AND the expected direction of moisture change (drier or wetter) is likely to reduce the species' distribution, abundance, or habitat quality. If this second condition is not met (e.g., species dependent on springs tied to a regional aquifer that would not be expected to change significantly with climate change), the species should be scored as Neutral. Examples for Greatly Increase include plants that are exclusively or very strongly associated with localized moist microsites (e.g., "hanging gardens" in arid landscapes).</p>
<p><i>Increase Vulnerability:</i></p>	<p>Moderately (50-90% of occurrences or range) dependent on a strongly seasonal hydrologic regime and/or a specific aquatic/wetland habitat or localized moisture regime that is highly vulnerable to loss or reduction with climate change AND the expected direction of moisture change (drier or wetter) is likely to reduce the species' distribution, abundance, or habitat quality. If this second condition is not met, the species should be scored as Neutral. Examples for Increase include certain plants whose life cycles are highly synchronized with Mediterranean precipitation patterns in areas vulnerable to large changes in the amount and seasonal distribution of precipitation. Also included are desert or semi-desert plants that frequently occur in but are not restricted to or almost restricted to moisture-accumulating microsites, as well as plants (and animals that depend on these species) for which >50% of populations occur in areas such as sandy soils that are sensitive to changes in precipitation.</p>
<p><i>Somewhat Increase Vulnerability:</i></p>	<p>Somewhat (10-50%) dependent on a strongly seasonal hydrologic regime and/or a specific aquatic/wetland habitat or localized moisture regime that is highly vulnerable to loss or reduction with climate change AND the expected direction of moisture change (drier or wetter) is likely to reduce the species' distribution, abundance, or habitat quality. If this second condition is not met, the species should be scored as Neutral. Examples: plants (and animals that depend on these species) for which 10-50% of populations occur in areas such as sandy soils that are sensitive to changes in precipitation; certain plants with ranges restricted to seasonal precipitation environments (e.g., summer rainfall deserts) and which have a moderate degree of adaptation to that seasonality.</p>
<p><i>Neutral:</i></p>	<p>Species has little or no dependence on a strongly seasonal hydrologic regime and/or a specific aquatic/wetland habitat or localized moisture regime that is highly vulnerable to loss or reduction with climate change OR hydrological requirements are not likely to be significantly disrupted in major portion of the range.</p>

<i>Somewhat Decrease Vulnerability:</i>	Species has very broad moisture regime tolerances OR would benefit by the predicted change in hydrologic regime. Examples include water-limited species that could increase with increasing precipitation or arid-adapted species that could increase in areas with decreasing moisture availability.
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Most of the rare plants are already adapted to wide variations in wet versus dry years. Wetland species, cliff/canyon species restricted to seeps, alpine species that prefer wetter micro-sites, were rated ‘Greatly Increase.’ Alpine species that are not restricted to wetter micro-sites were rated ‘Neutral.’ Shrubland species were rated ‘Somewhat Increase’ for their dependence on seasonal hydrologic regimes. All other species were rated ‘Increase’ based on the assumption that most areas within Colorado will get drier (note that there is much less agreement among climate models on predictions for precipitation than there is for temperature). Photosynthetic pathways are unknown for the rare plants, but in all cases where pathways were known for other species in these Genera, those species were C3 (i.e., more vulnerable to decline under drying conditions than C4 plants would be).

(c.) **dependence on specific disturbance regime:** This factor pertains to a species' response to specific disturbance regimes such as fires, floods, severe winds, pathogen outbreaks, or similar events. Definitions of scoring categories are:

<i>Increase Vulnerability:</i>	Strongly affected by specific disturbance regime, and climate change is likely to change the frequency, severity, or extent of that disturbance regime in a way that reduces the species' distribution, abundance, or habitat quality. For example, many sagebrush-associated species in regions predicted to experience increased fire frequency/intensity would be scored here due to the anticipated deleterious effects of increased fire on their habitat.
<i>Somewhat Increase Vulnerability:</i>	Moderately affected by specific disturbance regime, and climate change is likely to change the frequency, severity, or extent of that disturbance regime in a way that reduces the species' distribution, abundance, or habitat quality, OR strongly affected by specific disturbance regime, and climate change is likely to change that regime in a way that causes minor disruption to the species' distribution, abundance, or habitat quality. For example, plants in a river scour community that are strongly tied to natural erosion and deposition flood cycles, which may shift position within the channel rather than disappear as a result of climate change.
<i>Neutral:</i>	Little or no response to a specific disturbance regime or climate change is unlikely to change the frequency, severity, or extent of that disturbance regime in a way that affects the range or abundance of the species.

<i>Somewhat Decrease Vulnerability:</i>	Moderately affected by specific disturbance regime, and climate change is likely to change the frequency, severity, or extent of that disturbance regime in a way that increases the species' distribution, abundance, or habitat quality. Many fire-adapted plants can be scored here if a predicted increase in fire frequency/intensity is anticipated to be beneficial.
<i>Decrease Vulnerability:</i>	Strongly affected by specific disturbance regime, and climate change is likely to change the frequency, severity, or extent of that disturbance regime in a way that increases the species' distribution, abundance, or habitat quality (e.g., in areas predicted to experience increased fire frequency, invasive grasses that have a strong positive response to fire (e.g., ecosystem function-altering) could be scored here.

Species that primarily inhabit forest habitats were rated 'Increase' based on the assumption that these systems will be likely to experience more frequent and intense disturbance events (e.g., fire, insect outbreaks) under projected climate change scenarios. One exception to this is *Ipomopsis aggregata* ssp. *weberi*, which was rated 'Neutral' based on increasing numbers in the wake of landscape-scale beetle kill. Species that inhabit shrublands and pinyon-juniper were rated 'Somewhat Increase' based on the assumption that these habitats would be more likely to burn under climate change scenarios due to increased temperatures and increase in weedy understory (especially cheatgrass). *Spiranthes diluvialis* was rated 'Somewhat Increase' based on potential for flooding. All other species were rated 'Neutral.'

(d.) **dependence on ice, ice-edge, or snow covered habitats:** Alpine species were rated 'Somewhat Increase' with the exception of *Draba graminea* and *D. grayana* which were rated 'Greatly Increase', all other species were rated 'Neutral.' Definitions of scoring factors are:

<i>Greatly Increase Vulnerability:</i>	Highly dependent (>80% of subpopulations or range) on ice- or snow-associated habitats; or found almost exclusively on or near ice or snow during at least one stage of the life cycle.
<i>Increase Vulnerability:</i>	Moderately dependent (50-80% of subpopulations or range) on ice- or snow-associated habitats; or often found most abundantly on or near ice or snow but also regularly occurs away from such areas.
<i>Somewhat Increase Vulnerability:</i>	Somewhat (10-49% of subpopulations or range) dependent on ice- or snow-associated habitats, or may respond positively to snow or ice but is not dependent on it. For example, certain alpine plants are often associated with long-lasting snowbeds but also commonly occur away from such areas; certain small mammals experience increased survival and may develop relatively large populations under winter snow cover but do not depend on snow cover. Species that benefit from a minimum thickness of ice or snowpack for winter insulation should also be scored here.
<i>Neutral:</i>	Little dependence on ice- or snow-associated habitats (may be highly dependent in up to 10% of the range).

3. **Restriction to uncommon geological features or derivatives** - This factor pertains to a species' need for a particular soil/substrate, geology, water chemistry, or specific physical feature (e.g., caves, cliffs, active sand dunes) for reproduction, feeding, growth, or otherwise existing for one or more portions of the life cycle (e.g., normal growth, shelter, reproduction, seedling establishment). It focuses on the commonness of suitable conditions for the species on the landscape, as indicated by the commonness of the features themselves combined with the degree of the species' restriction to them. Climate envelopes may shift away from the locations of fixed (within at least a 50 year timeframe) geological features or their derivatives, making species tied to these uncommon features potentially more vulnerable to habitat loss from climate change than are species that thrive under diverse conditions. Definitions of scoring categories are:

<p><i>Increase Vulnerability:</i></p>	<p>Very highly dependent upon, i.e., more or less endemic to (> 85% of occurrences found on) a particular highly uncommon geological feature or derivative (e.g., soil, water chemistry). Such features often have their own endemics. Examples include serpentine (broad and strict) endemic plants, plants of calcareous substrates where such substrates are uncommon (e.g., California, southeastern U.S.), plants restricted to one or a few specific rock strata, organisms more or less restricted to inland sand dunes or shale barrens, obligate cave-dwelling organisms, and spring snails restricted to springs with high dissolved CO₂. This category could also include fish species that require a highly uncommon substrate particle size for their stream bottoms, such as the Colorado pike minnow (<i>Ptychocheilus lucius</i>) that spawns only on rare cobble bars cleared of debris by strong upstream currents.</p>
<p><i>Somewhat Increase Vulnerability:</i></p>	<p>Moderately to highly dependent upon a particular geological feature or derivative, i.e., (1) an indicator of but not an endemic to (65-85% of occurrences found on) the types of features described under Increase, OR (2) more or less restricted to a geological feature or derivative that is not highly uncommon within the species' range, but is not one of the dominant types. Examples of the latter include species more or less restricted to active coastal sand dunes, cliffs, salt flats (including shorebirds that require sodic soils), inland waters within a particular salinity range, and non-dominant rock types such as occasional igneous rock intrusions within a landscape mostly dominated by sedimentary and/or metamorphic rocks. This category could also include fish species that require a specific substrate particle size for their stream bottoms, if that type of stream bottom is not one of the dominant types within the species' range.</p>

<p><i>Neutral:</i></p>	<p>Having a clear preference for (> 85% of occurrences found on) a certain geological feature or derivative, where the feature is among the dominant types within the species' range. For example, red spruce prefers acidic, organic soils (not uncommon within its range), although it is occasionally found on other soil types. Many species whose habitat descriptions specify one pH category (acidic, neutral, or basic) and/or one soil particle size (e.g., rocky, sandy, or loamy) will probably fall here, upon confirmation that the substrate type is not particularly uncommon within the species' range.</p>
<p><i>Somewhat Decrease Vulnerability:</i></p>	<p>Somewhat flexible but not highly generalized in dependence upon geological features or derivatives, i.e., found on a subset of the dominant substrate/water chemistry types within its range. Most habitat descriptions that mention more than one type of relatively widespread geological feature should probably go here; however, if all types mentioned are uncommon within the species' range, Somewhat Increase may be appropriate. This category also encompasses species not strongly tied to any specific geological feature or derivative, such as many birds and mammals.</p>
<p><i>Decrease Vulnerability:</i></p>	<p>Highly generalized relative to dependence upon geological features or derivatives, i.e., the species is described as a generalist and/or a significant proportion of its occurrences have been documented on substrates or in waters that represent opposite ends of the spectrum of types within the assessment region (e.g., many occurrences known from both acidic and basic soils or waters, or from both sandy and clay soils). Species such as common yarrow (<i>Achillea millefolium</i>) and coyote (<i>Canis latrans</i>) should be assigned to this category.</p>

Species that are tied primarily to barrens habitats were rated 'Increase' or 'Somewhat Increase'. *Ipomopsis globularis* and *Saussurea weberi* were also rated 'Increase' based on their restriction to calcareous substrates. Cliff/canyon species were rated 'Somewhat Increase.' Several species that are known to occur on various substrates were rated 'Somewhat Decrease' based on the assumption that species occupying multiple substrates will be better able to shift their range/distribution in response to changing habitat conditions. All others were rated 'Neutral.'

4. **Reliance on specific interactions** - The primary impact of climate change on many species may occur via effects on synchrony with other species on which they depend, rather than through direct physiological stress.

(a) **Dependence on other species to generate habitat:** rated 'Neutral' for all species.

Definitions of scoring categories are:

<i>Greatly Increase Vulnerability:</i>	Required habitat generated primarily by one species, and that species is highly to extremely vulnerable to climate change within the assessment area.
<i>Increase Vulnerability:</i>	Required habitat generated primarily by one species, and that species is at most moderately vulnerable to climate change within the assessment area. See examples of species requiring other species to generate habitat under Greatly Increase Vulnerability. If the climate change vulnerability of the habitat-generating species is unknown, check both Greatly Increase and Increase Vulnerability.
<i>Somewhat Increase Vulnerability:</i>	Required habitat generated primarily by one or more of not more than a few species. For example, a certain degree of specificity exists between particular cactus species and certain nurse plants; burrowing owls (<i>Athene cunicularia</i>) depend on excavations made by relatively few species of burrowing mammals; certain plant species depend on large grazing animals to generate disturbance required for establishment and early growth.
<i>Neutral:</i>	Required habitat generated by more than a few species, or does not involve species-specific processes.

(b) **Dietary versatility:** not applicable to plants.

(c) **Pollinator versatility:** *Physaria congesta*, the *Penstemon* species and the *Sclerocactus* species were rated 'Somewhat Increase' based on the need for pollinators, which are thought to be comprised of several genera and species (Clark 2013). *Astragalus* species were rated 'Neutral' based on the USFS species assessments for *Astragalus anisus* and *A. missouriensis* var. *humistratus*, which indicated some western *Astragalus* species are visited by over 27 species of bees. This rating was extrapolated to the other *Astragalus* species. Note that pollinators of these Colorado *Astragalus* species have not been identified, so this extrapolation is based on an untested assumption. *Ptilagrostis* and *Puccinellia*, were rated 'Neutral' because they are wind pollinated. All others were rated either 'Neutral' based on recent research or species assessments e.g. Tepedino 2009, Tepedino et al. 2011) or 'Unknown.'

Definitions of scoring categories are:

<i>Increase Vulnerability:</i>	Completely or almost completely dependent on one species for pollination (> 90% of effective pollination accomplished by 1 species) or, if no observations exist, morphology suggests very significant limitation of potential pollinators (e.g., very long corolla tube).
<i>Somewhat Increase Vulnerability:</i>	Completely or almost completely dependent on 2-4 species for pollination (> 90% of effective pollination accomplished by 2-4 species) or, if no observations exist, morphology suggests conformation to a specific "pollination syndrome" (e.g., van der Pijl

	1961, Evolution 15: 44-59, http://www.fs.fed.us/wildflowers/pollinators/syndromes.shtml).
<i>Neutral:</i>	Pollination apparently flexible; five or more species make significant contributions to pollination or, if no observations exist, morphology does not suggest pollinator limitation or pollination syndrome.

(d) **Dependence on other species for propagule dispersal:** All species were rated 'Neutral.'

Definitions for scoring categories are:

<i>Increase Vulnerability:</i>	Completely or almost completely (roughly > 90%) dependent on a single species for propagule dispersal. For example, whitebark pine would fit here because Clark's nutcracker is the primary dispersal agent.
<i>Somewhat Increase Vulnerability:</i>	Completely or almost completely (roughly > 90%) dependent on a small number of species for propagule dispersal. For example, a freshwater mussel for which only a few species of fish can disperse larvae.
<i>Neutral:</i>	Disperses on its own (most animals) OR propagules can be dispersed by more than a few species.

(e) **Other inter-specific interactions:** This factor refers to interactions unrelated to habitat, seedling establishment, diet, pollination, or propagule dispersal. Here an inter-specific interaction can include mutualism, parasitism, commensalism, or predator-prey relationship.

Definitions for scoring categories are:

<i>Increase Vulnerability:</i>	Requires an interaction with a single other species for persistence.
<i>Somewhat Increase Vulnerability:</i>	Requires an interaction with a one member of a small group of taxonomically related species for persistence. Could also include cases where specificity is not known for certain, but is suspected. Many Orchidaceae will be in this category because of their requirement for a specific fungal partner for germination (Tupac Otero and Flanagan 2006, TREE 21: 64-65).
<i>Neutral:</i>	Does not require an interspecific interaction or, if it does, many potential candidates for partners are available.

The *Astragalus* species were rated 'Somewhat Increase' based on their known symbiotic relationship with *Rhizobium* bacteria to fix nitrogen. All others were rated either 'Neutral' based on species assessments, or 'Unknown.'

- 5. **Genetic factors** – Rated ‘Unknown’ for all species.
- 6. **Phenological response** – Rated ‘Unknown’ for all species.

Section D – Documented or modeled response to climate change

All species rated ‘Unknown’ for each factor in this section

Results of the CCVI analysis for PGCN

Of the 117 species scored 111 were Extremely Vulnerable or Highly Vulnerable (Table B1). Scoring factors are summarized by number of species receiving each possible score in Table B2. Table B3 details the results of the CCVI analysis by species. See Part 3 (Problems Affecting the Species) of this document for discussion.

Table B1. Summary of climate change vulnerability scores for PGCN.

Index Score	Number of PGCN
Extremely Vulnerable	104
Highly Vulnerable	7
Moderately Vulnerable	2
Presumed Stable	1
Insufficient Evidence	3

Table B2. Number of PGCN in each scoring category, by exposure and sensitivity factors.

*These factors are calculated as percent of range (e.g., a species range may have 80% in one category and 20% in another category). Number of species column reflects number of species for which the greatest percentage of the range falls within the scoring category.

Scoring Factor	Score	Number of Species
Exposure to temperature increase*	>5.5	100
	5.5 – 5.1	14
	Unknown distribution	3
Exposure to reduction in moisture*	<-.119	6
	0.119	47
	0.096	47

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Scoring Factor	Score	Number of Species
	0.073	13
	0.05	1
	Unknown distribution	3
Natural Barriers	Greatly Increase	5
	Increase	75
	Somewhat Increase	15
	Neutral	20
	Unknown	2
Anthropogenic Barriers	Greatly Increase	2
	Increase	11
	Somewhat Increase	31
	Neutral	70
	Unknown	3
Climate Change Mitigation	Increase	49
	Somewhat Increase	9
	Neutral	52
	Somewhat Decrease	5
	Unknown	2
Dispersal	Greatly Increase	1
	Increase	108
	Somewhat Increase	4
	Neutral	3
	Somewhat Decrease	0
	Decrease	0
	Unknown	1
Historical Thermal Niche	Greatly Increase	0
	Increase	0
	Somewhat Increase	0

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Scoring Factor	Score	Number of Species
	Neutral	80
	Somewhat Decrease	34
	Unknown	3
Physiological Thermal Niche	Greatly Increase	0
	Increase	29
	Somewhat Increase	2
	Neutral	85
	Somewhat Decrease	0
	Unknown	1
Historical Hydrological Niche	Greatly Increase	36
	Increase	48
	Somewhat Increase	20
	Neutral	10
	Somewhat Decrease	0
	Unknown	3
Physiological Hydrological Niche	Greatly Increase	15
	Increase	62
	Somewhat Increase	29
	Neutral	10
	Somewhat Decrease	0
	Unknown	1
Disturbance Regime	Increase	3
	Somewhat Increase	43
	Neutral	70
	Somewhat Decrease	0
	Decrease	0
	Unknown	1
Dependence on Ice/Snow	Greatly Increase	2

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Scoring Factor	Score	Number of Species
	Increase	0
	Somewhat Increase	13
	Neutral	101
	Unknown	1
Physical Habitat Restriction	Increase	30
	Somewhat Increase	20
	Neutral	61
	Somewhat Decrease	5
	Decrease	0
	Unknown	1
Dependence on Other Species to Generate Habitat	Greatly Increase	0
	Increase	0
	Somewhat Increase	0
	Neutral	116
	Unknown	1
Pollinator Versatility	Increase	0
	Somewhat Increase	14
	Neutral	57
	Unknown	46
Dependence on Other Species for Propagule Dispersal	Increase	0
	Somewhat Increase	0
	Neutral	114
	Unknown	3
Other Species Interactions (e.g., mutualisms)	Increase	0
	Somewhat Increase	20
	Neutral	15
	Unknown	82

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Table B3. Climate Change Vulnerability Index results for PGCN. GI = Greatly Increase; Inc = Increase; SI = Somewhat Increase; N = Neutral; SD = Somewhat Decrease; D = Decrease; U = Unknown; EV = Extremely Vulnerable; HV = Highly Vulnerable; MV = Moderately Vulnerable; PS = Presumed Stable; IE = Insufficient Evidence to score.

 Species Common Name		Temperature Scope		Hamon AET:PET Moisture Metric Scope					Natl barriers	Anth barriers	CC mitigation	Dispersal / Movement	Historical thermal niche	Physiological thermal niche	Historical hydrological niche	Physiological hydrological niche	Disturbance	Ice/snow	Phys habitat	Other spp for hab	Pollinators	Other spp disp	Other spp interaction	Vulnerability Score
		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
Tier 1																								
<i>Aletes latilobus</i>	Canyonlands aletes	100					100		Inc	Inc	N	Inc	N	Inc	GI	Inc	N	N	SI	N	U	N	U	EV
<i>Aliciella sedifolia</i>	Stonecrop gilia	100				93	7		GI	N	N	Inc	N	Inc	GI	GI	N	SI	N	N	U	N	U	EV
<i>Astragalus deterior</i>	Cliff-palace milkvetch	100					100		Inc	Inc-SI	N	Inc	N	Inc	Inc	Inc	N	N	SI	N	N	N	SI	EV
<i>Astragalus humillimus</i>	Mancos milkvetch	100					100		Inc	N	N	Inc	N	Inc	GI	Inc	N	N	SI	N	N	N	SI	EV
<i>Astragalus microcymbus</i>	Skiff milkvetch	100		97	3				SI-N	SI-N	Inc	Inc	SD	SI	Inc	SI	SI	N	N	N	N	N	SI	EV
<i>Astragalus osterhoutii</i>	Kremmling milkvetch	100			100				SI	N	SI	Inc	SD	N	Inc	SI	SI	N	SI	N	N	N	SI	EV
<i>Astragalus schmolliae</i>	Sleeping Ute milkvetch	100				100			Inc	N	N	Inc	N	N	Inc	Inc	SI	N	N	N	N	N	SI	EV
<i>Astragalus tortipes</i>	Sleeping Ute milkvetch	100					100		Inc-SI	Inc-SI	Inc	Inc	N	N	GI	SI	SI	N	N	N	N	N	SI	EV
<i>Boechera glareosa</i>		100			100				Inc	N	Inc	Inc	N	N	GI	Inc	N	N	Inc	N	U	N	U	EV
<i>Corispermum navicula</i>	Boat-shaped bugseed	100			33	67			Inc	N	N	Inc	N	N	GI	Inc	N	N	Inc	N	U	N	U	EV


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		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Descurainia kenheillii</i>	Heil's tansy mustard	100					100		Inc	N	N	Inc	N	Inc	GI	N	N	SI	N	N	U	N	U	EV
<i>Draba malpighiacea</i>	Whitlow-grass	100				100			Inc	N	SD	Inc	N	N	Inc	Inc	SI	N	N	N	U	N	U	EV
<i>Draba weberi</i>	Weber's draba	100				100			GI	N	N	Inc	N	Inc	GI	GI	N	SI	N	N	N	N	N	EV
<i>Erigeron wilkenii</i>	Wilken fleabane	100			100				Inc	N	N	Inc	N	Inc	GI	Inc	N	N	SI	N	N	U	U	EV
<i>Eriogonum brandegeei</i>	Brandegeee wild buckwheat	100		86	14				Inc	N	N	SI-N	N	N	Inc	Inc	N	N	Inc	N	N	N	N	EV
<i>Eriogonum pelinophilum</i>	Clay-loving wild buckwheat	100				48	52		Inc	Inc	Inc	Inc	SD	N	Inc	SI	SI	N	SI	N	N	N	U	EV
<i>Eutrema penlandii</i>	Penland alpine fen mustard	100			28	72			Inc	N	N	Inc	N	Inc	N	GI	N	SI	N	N	U	N	U	EV
<i>Gutierrezia elegans</i>	Lone Mesa snakeweed	100			100				Inc	SI	Inc	Inc	N	N	GI	SI	N	N	Inc	N	U	N	U	EV
<i>Hackelia gracilentia</i>	Mesa Verde stickseed	100				100			N	SI	N	Inc	N	N	Inc	Inc	SI	N	N	N	U	N	U	EV
<i>Ipomopsis polyantha</i>	Pagosa skyrocket		100		100				Inc	Inc	Inc	Inc	SD	N	GI	Inc	N	N	Inc	N	N	N	U	EV
<i>Ipomopsis ramosa</i>	coral ipomopsis	100			18	82			N	N	SD	Inc	N	N	Inc	Inc	Inc	N	N	N	SI-N	N	U	HV
<i>Lepidium huberi</i>	Huber's pepperweed	100		19	42	22	16	1	SI	N	N	Inc	N	N	SI	SI	SI	N	N	N	N	N	U	HV
<i>Lygodesmia doloresensis</i>	Dolores River skeletonplant	100				98	2		SI	SI	N	Inc	SD	N	Inc	Inc	SI	N	N	N	U	N	U	EV


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		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Mimulus gemmiparus</i>	Budding monkey flower	100				71	29		Inc	N	N	GI	N	Inc	SI	GI	N	N	SI	N	N	N	U	EV
<i>Oenothera coloradensis</i> ssp. <i>coloradensis</i>	Colorado butterfly plant	47	53		47	53			Inc	GI-Inc	N	Inc	N	N	Inc	GI	N	N	SD	N	U	N	U	EV
<i>Oreoxis humilis</i>	Pikes Peak spring parsley	100			18	3	79		Inc	N	N	Inc	N	Inc	Inc	N	N	SI	N	N	N	N	U	EV
<i>Packera mancosana</i>	Mancos shale packera	100			100				Inc	N	N	Inc	N	N	GI	Inc	N	N	Inc	N	N	N	U	EV
<i>Pediocactus knowltonii</i>	Knowlton cactus								U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	IE
<i>Penstemon debilis</i>	Parachute penstemon	100			92	8			Inc	N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	SI	N	U	EV
<i>Penstemon gibbensii</i>	Gibben's beardtongue	100				100			Inc	N	Inc	Inc	SD	N	GI	Inc	N	N	Inc	N	SI	N	U	EV
<i>Penstemon penlandii</i>	Penland penstemon	100			100				SI	SI	SI	Inc	SD	N	GI	SI	SI	N	N	N	SI	N	U	EV
<i>Penstemon scariosus</i> var. <i>albifluvis</i>	White River penstemon	100					100		Inc	N	Inc	Inc	SD	N	GI	Inc	N	N	Inc	N	SI	N	U	EV
<i>Phacelia formosula</i>	North Park phacelia	100			99	1			Inc	N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	SI	N	U	EV
<i>Phacelia gina-glennae</i>	Troublesome phacelia	100			100				SI	SI	SI	Inc	SD	N	GI	Inc	SI	N	N	N	N	U	U	EV
<i>Phacelia submutica</i>	DeBeque phacelia	100			4	95	1		Inc	Inc-SI	Inc	Inc	SD	N	GI	Inc	N	N	Inc	N	U	N	U	EV


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		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Physaria congesta</i>	Dudley Bluffs bladderpod	100			100				Inc	Inc	Inc	Inc	N-SD	N	GI	Inc	N	N	Inc	N	SI	N	U	EV
<i>Physaria obcordata</i>	Piceance twinpod	100			100				Inc	N	Inc	Inc	SD	N	Inc	Inc	N	N	Inc	N	N	N	U	EV
<i>Physaria pulvinata</i>	Cushion bladderpod	100			100				Inc	SI-N	Inc	Inc	N	N	Inc	SI	N	N	Inc	N	U	N	U	EV
<i>Physaria rollinsii</i>	Rollins twinpod	100		22	34	37	7		Inc	SI-N	Inc	Inc	SD	N	SI	SI	N	N	Inc	N	U	N	U	EV
<i>Physaria scrotiformis</i>	West Silver bladderpod	100				100			Inc	N	Inc	Inc	N	N	GI	Inc	N	N	SD	N	U	N	U	EV
<i>Sclerocactus glaucus</i>	Colorado hookless cactus	100		1	1	12	86		Inc-SI	SI-N	Inc	Inc	SD	N	Inc	SI	SI	N	N	N	SI	N	U	EV
<i>Sclerocactus mesa-verde</i>	Mesa Verde hookless cactus	100					100		Inc	N	Inc	Inc	N	N	GI	Inc	N	N	Inc	N	SI	N	U	EV
<i>Spiranthes diluvialis</i>	Ute ladies' tresses	88	12		67	33			GI- Inc	GI- Inc	N	Inc	SD	N	SI	GI	SI	N	N	N	U	N	U	EV
Tier 2																								
<i>Aletes humilis</i>	Larimer Aletes	60	40			100			Inc	N	SD	Inc	N	Inc	Inc	Inc	N	N	SI	N	N	N	N	EV
<i>Aletes macdougallii</i> ssp. <i>Breviradiatus</i>	Mesa Verde aletes	100				100			N	SI-N	N	Inc	N	N	GI	Inc	SI	N	N	N	U	N	U	EV
<i>Anticlea vaginatus</i>	Alcove death camas	100			100				Inc	N	N	Inc	N	Inc	GI	GI	N	N	SI	N	U	N	U	EV
<i>Asclepias uncialis</i> ssp. <i>uncialis</i>	Dwarf milkweed	23	77		71	29			N	SI	Inc	SI	SD	N	Inc	Inc	N	N	N	N	N	N	N	EV


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		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Astragalus anisus</i>	Gunnison milkvetch	100		45	55				SI	SI	Inc	Inc	SD	N	Inc	SI	SI	N	N	N	N	N	SI	EV
<i>Astragalus cronquistii</i>	Cronquist milkvetch	100					28	72	N	N	Inc	Inc	N	N	Inc	SI	SI	N	N	N	N	N	SI	EV
<i>Astragalus debequaeus</i>	DeBeque milkvetch	100				99	1		Inc	SI	Inc	Inc	SD	N	Inc	Inc	N	N	SI	N	N	N	SI	EV
<i>Astragalus equisolensis</i>	Horseshoe milkvetch	100				100			SI-N	N	SI	Inc	N	N	Inc	Inc	SI	N	N	N	N	N	SI	EV
<i>Astragalus iodopetalus</i>	Violet milkvetch	41	59		59	41			N	SI	Inc	Inc	N	N	GI	Inc	SI	N	N	N	N	N	SI	EV
<i>Astragalus missouriensis</i> var. <i>humistratus</i>	Sleeping Ute milkvetch		100		100				Inc-SI	N	Inc	Inc	SD	N	Inc	SI	SI	N	SD	N	N	N	SI	EV
<i>Astragalus naturitensis</i>	Naturita milkvetch	100				98	2		Inc-SI	SI-N	N	Inc	SD	Inc	Inc	Inc	SI	N	SI	N	N	N	SI	EV
<i>Astragalus piscator</i>	Fisher Towers milkvetch	100				100			N	N	Inc	Inc	N	N	GI	SI	SI	N	N	N	N	N	SI	EV
<i>Astragalus rafaensis</i>	San Rafael milkvetch	100				91	9		Inc	N	N	Inc	N	N	GI	Inc	SI	N	N	N	N	N	SI	EV
<i>Astragalus sparsiflorus</i>	Front Range milkvetch	100			89	11			N	SI	N	Inc	N	N	SI	Inc	Inc	N	N	N	N	N	SI	EV
<i>Boechera crandallii</i>	Crandall's rock cress	100		36	63	1			N	N	Inc	Inc	SD	N	SI	SI	SI	N	N	N	N	N	N	EV
<i>Botrychium lineare</i>	Narrowleaf grape fern	100		7		93			Inc	N	SD	Inc	N	N	SI	SI	SI	N	SD	N	N	N	U	HV


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		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Calochortus ciscoensis</i>	Cisco sego lily	100				2	51	47	Inc	SI	N	Inc	SD	N	GI	SI	SI	N	SI	N	N	N	U	EV
<i>Camissonia eastwoodiae</i>	Eastwood evening primrose	100				42	50	8	N	N	Inc	Inc	SD	N	Inc	SI	SI	N	N	N	U	N	U	HV
<i>Castilleja puberula</i>	Downy Indian-paintbrush	90	10		1	90	8	1	Inc	N	N	Inc	N	Inc	N	N	N	SI	N	N	U	N	U	EV
<i>Cirsium perplexans</i>	Adobe thistle	100			62	38			N	N	Inc	N	SD	N	SI	SI	SI	N	N	N	N	N	N	MV
<i>Cleome multicaulis</i>	Slender spiderflower	2	98			46	54		GI	N	Inc	Inc	SD	N	GI	GI	N	N	N	N	U	N	U	EV
<i>Delphinium ramosum</i> var. <i>alpestre</i>	Colorado larkspur	94	6	3	46	48	3		Inc	N	N	Inc	N	Inc	SI	N	N	SI	N	N	U	N	U	EV
<i>Delphinium robustum</i>	Wahatoya Creek larkspur								Inc	U	U	Inc	U	Inc	U	Inc	N	N	SI	N	N	N	N	IE
<i>Draba exunguiculata</i>	Clawless draba	100			32	52	16		Inc	N	N	Inc	N	Inc	SI	N	N	SI	N	N	N	N	N	EV
<i>Draba graminea</i>	San Juan whitlow-grass	100				75	25		Inc	N	N	Inc	N	Inc	SI	GI	N	GI	N	N	N	N	N	EV
<i>Draba grayana</i>	Gray's Peak whitlow-grass	77	23		33	66	1		Inc	N	N	Inc	N	Inc	N	N	N	GI-SI	N	N	N	N	N	EV
<i>Draba smithii</i>	Smith Whitlow-grass	54	46	1	26	35	14	24	Inc	N	N	Inc	N	Inc	N	Inc	N	N	SI	N	N	N	N	EV
<i>Erigeron kachinensis</i>	Kachina daisy	100				100			Inc	N	N	SI	N	Inc	GI	GI	N	N	SI	N	U	N	U	EV
<i>Eriogonum clavellatum</i>	Comb Wash buckwheat	100					99	1	N	SI	Inc	Inc	N	N	GI	SI	SI	N	N	N	N	N	U	EV


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 Species Common Name		Temperature Scope		Hamon AET:PET Moisture Metric Scope					Natl barriers	Anth barriers	CC mitigation	Dispersal / Movement	Historical thermal niche	Physiological thermal niche	Historical hydrological niche	Physiological hydrological niche	Disturbance	Ice/snow	Phys habitat	Other spp for hab	Pollinators	Other spp disp	Other spp interaction	Vulnerability Score
		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Eriogonum coloradense</i>	Colorado wild buckwheat	100		33	27	15	25		Inc	N	N	SI-N	N	Inc	N	Inc	N	SI	N	N	N	N	N	EV
<i>Frasera coloradensis</i>	Colorado green gentian	100			100				SI	SI	SI-N	Inc	N	N	GI	Inc	N	N	SI	N	N	N	U	EV
<i>Herrickia horrida</i>	Canadian River spiny aster		100		13	87			SI-N	N	N	Inc	N	N	GI	Inc	SI	N	N	N	U	N	U	EV
<i>Ipomopsis aggregata ssp. weberi</i>	Rabbit Ears gilia	100			65	35			N	N	SD	Inc	SD	N	N	Inc	N	N	N	N	N	N	N	PS
<i>Ipomopsis globularis</i>	Globe gilia	100			45	55			Inc	N	N	Inc	N	Inc	Inc	N	N	SI	Inc	N	N	N	U	EV
<i>Lepidium crenatum</i>	Alkaline pepperwort	100		24	25	51			SI	SI	Inc	Inc	N	N	SI	SI	SI	N	N	N	U	N	U	EV
<i>Limnorchis zothecina</i>	Alcove bog orchid	100			100				Inc	N	N	Inc	SD	Inc	GI	GI	N	N	SI	N	U	N	U	EV
<i>Lomatium concinnum</i>	Colorado desert-parsley	100		42	9	49			SI	Inc-SI	Inc	Inc	N	N	Inc	SI	SI	N	SI	N	U	N	U	EV
<i>Lupinus crassus</i>	Payson lupine	100		3		97			SI	N	SI	Inc	SD	N	SI	Inc	SI	N	N	N	U	N	SI	EV
<i>Mentzelia paradoxensis</i>	Paradox stickleaf	100				80	20		N	N	N	Inc	N	N	Inc	SI	SI	N	N	N	N	N	U	HV
<i>Mentzelia rhizomata</i>	Roan Cliffs blazing star	100		2	93	5			Inc	N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	U	N	U	EV
<i>Mertensia humilis</i>	Rocky Mountain bluebells	100			76	24			Inc-SI	SI-N	Inc	Inc	N	N	SI	SI	SI	N	N	N	U	N	U	EV
<i>Nuttallia chrysantha</i>	Golden blazing star	71	29	10	28	62			Inc	SI-N	Inc	Inc-SI	N	N	Inc	Inc	N	N	Inc	N	N	N	U	EV


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 Species Common Name		Temperature Scope		Hamon AET:PET Moisture Metric Scope					Natl barriers	Anth barriers	CC mitigation	Dispersal / Movement	Historical thermal niche	Physiological thermal niche	Historical hydrological niche	Physiological hydrological niche	Disturbance	Ice/snow	Phys habitat	Other spp for hab	Pollinators	Other spp disp	Other spp interaction	Vulnerability Score
		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Nuttallia densa</i>	Arkansas Canyon stickleaf	100		2	98				Inc-SI	SI-N	N	Inc	N	N	Inc	Inc	SI	N	N	N	U	N	U	EV
<i>Oenothera acutissima</i>	Narrow-leaf evening primrose	100		4	70	26			N	N	N	Inc	N	N	Inc	SI	N	N	N	N	U	N	U	HV
<i>Oenopsis foliosa</i> var. <i>monocephala</i>	Rayless goldenweed		100		80	20			N	N	Inc	Inc	SD	N	Inc	Inc	N	N	N	N	U	N	U	EV
<i>Oenopsis puebloensis</i>	Pueblo goldenweed	1	99		5	95			Inc	SI-N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	U	N	U	EV
<i>Oreocarya osterhoutii</i>	Osterhout's cat's-eye	100				61	39		Inc	Inc-SI	Inc	Inc	SD	N	Inc	Inc	N	N	Inc	N	U	N	U	EV
<i>Oreocarya revealii</i>	Gypsum Valley cat's-eye	100			8	84	8		Inc	N	SI	Inc	N	N	Inc	Inc	SI	N	Inc	N	U	N	U	EV
<i>Oxybaphus rotundifolius</i>	Round-leaf four o'clock	7	93		21	79			Inc	SI-N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	U	N	U	EV
<i>Oxytropis besseyi</i> var. <i>obnapiformis</i>	Bessey locoweed	100			36	64			N	N	Inc	Inc	SD	N	SI	SI	SI	N	N	N	U	N	U	HV
<i>Penstemon acaulis</i> var. <i>yampaensis</i>	Yampa beardtongue	100			58	42			N	N	SI	Inc	N	N	SI	SI	SI	N	N	N	SI	N	U	EV
<i>Penstemon degeneri</i>	Degener beardtongue	100		29	71				N	N	N	Inc	N	N	Inc	Inc	SI	N	N	N	SI	N	U	EV
<i>Penstemon fremontii</i> var. <i>glabrescens</i>	Fremont's beardtongue	100		29	55	16			N	N	Inc	Inc	SD	N	Inc	Inc	SI	N	N	N	SI	N	U	EV
<i>Penstemon grahamii</i>	Graham beardtongue	100					100		Inc	N	Inc	Inc	SD	N	GI	Inc	N	N	Inc	N	SI	N	U	EV

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		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Penstemon mensarum</i>	Grand Mesa penstemon	100		9	60	11	20		SI	SI	SI	Inc	N	SI	N	SI	Inc	N	N	N	SI	N	U	EV
<i>Penstemon scariosus</i> var. <i>cyanomontanus</i>	Plateau penstemon	100			100				Inc	N	N	Inc	N	N	Inc	Inc	SI	N	N	N	SI	N	U	EV
<i>Physaria alpina</i>	Avery Peak twinpod	100			2	98			Inc	N	N	Inc	N	Inc	Inc	N	N	SI	N	N	U	N	U	EV
<i>Physaria bellii</i>	Bell's twinpod	42	58				100		Inc	SI	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	U	N	U	EV
<i>Physaria parviflora</i>	Piceance bladderpod	100		75	24	1			Inc	N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	U	N	U	EV
<i>Physaria pruinosa</i>	Pagosa bladderpod		100	1	95	4			Inc	SI	Inc	Inc	SD	N	Inc	Inc	N	N	Inc	N	N	N	N	EV
<i>Physaria vicina</i>	Good-neighbor bladderpod	100		6	49	42	3		Inc	Inc	N	Inc	N	N	Inc	Inc	SI	N	SI	N	U	N	U	EV
<i>Potentilla rupincola</i>	Rocky Mountain cinquefoil	93	7			100			Inc	N	N	Inc	N	Inc	N	Inc	N	N	SI	N	N	N	SI	EV
<i>Ptilagrostis porteri</i>	Porter's feathergrass	100		7	45	44	4		Inc-SI	N	N	N	N	N	N	GI	N	N	N	N	N	N	U	MV
<i>Puccinellia parishii</i>	Parish's alkali grass	100			100				Inc	SI	N	N	N	N	GI	GI	N	N	N	N	N	N	U	EV
<i>Salix arizonica</i>	Arizona willow		100		100				GI-Inc	N	N	Inc	N	N	GI	GI	N	N	N	N	N	N	SI	EV
<i>Saussurea weberi</i>	Weber saussurea	100			8	92			Inc	N	N	Inc	N	Inc	SI	N	N	SI	N	N	N	N	U	EV
<i>Telesonix jamesii</i>	James telesonix	100			23	53	24		Inc	N	N	Inc	N	Inc	SI	Inc	N	N	SD	N	N	N	U	EV

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		>5.5F	5.1-5.5F	< -0.119	-0.097 to -0.119	-0.074 to -0.096	-0.051 to -0.073	-0.028 to -0.05																
<i>Thalictrum heliophilum</i>	Sun-loving meadow rue	100		72	28				Inc	N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	N	N	U	EV
<i>Thelypodopsis juniperorum</i>	Juniper tumble mustard	100			83	17			Inc-SI	SI-N	N	Inc	N	N	SI	Inc	SI	N	N	N	N	N	N	EV
<i>Thelypodium paniculatum</i>	Northwestern thelypody								U	U	N	Inc	U	N	U	GI	N	N	N	N	U	N	U	IE
<i>Townsendia fendleri</i>	Fendler's townsend-daisy	100		25	73	2			Inc	N	Inc	Inc	N	N	Inc	Inc	N	N	Inc	N	U	N	U	EV
<i>Townsendia glabella</i>	Gray's townsend-daisy	47	53		77	23			Inc	SI-N	Inc	Inc	SD	N	SI	Inc	N	N	Inc	N	N	N	U	EV
<i>Townsendia rothrockii</i>	Rothrock townsend-daisy	100		16	42	31	11		Inc	N	N	Inc	N	Inc	N	N	N	SI	N	N	N	N	U	EV
<i>Trifolium dasyphyllum ssp. anemophilum</i>	Whip-root clover	100			100				SI	Inc	Inc	Inc	N	N	GI	SI	N	N	N	N	N	N	SI	EV

APPENDIX C: IMPORTANT PLANT AREAS

B1 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan (CAP)	Designated Natural Area	ACEC or RNA
Cascade Falls			
Castle Gardens			
Chapin Mesa			
Devils Staircase			
Dolores Canyon South			
Droney Gulch		X	X
Dudley Bluffs	X	X	X
East Sand Dunes		X	
East Toe South			
Elk Falls		X	
Gateway		X	X
Great Sand Dunes-Mishak Lakes		X	
Gunnison Basin		X	X
Half Peak			
Hankins Gulch			
Laramie River Valley Shale Outcrops			
Mill Creek at Pagosa Springs	X		
Miramonte Reservoir West	X	X	
Mosquito Range-Hoosier Ridge		X	X
Mount Callahan		X	
Navajo Wash			
North Park Natural Area	X	X	X
Pikes Peak			
Plateau Creek	X		
Rabbit Mountain		X	
Rare Plants of the Chalk Barrens	X		
Rare Plants of the Wasatch		X	X
Rattlesnake Canyon			
Saint Vrain Mountain			
South Beaver Creek		X	X
Spitzie Draw			
Troublesome Creek	X		
Yampa River and Johnson Canyon			

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B2 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan	Designated Natural Area	ACEC or RNA
4A Ridge			
Alkali Creek			
Along Route 9			
Antelope Springs			
Antero Reservoir		X	
Anvil Points			
Anvil Points Rim			
B50 Road			
Baca Grande and Reserve			
Badger Creek Tunnel			
Bar X Wash			
Barrel Spring Point			X
Beaver Creek at Beaver Ridge			
Bellows Creek		X	
Big Dominguez Creek			
Big Gypsum Valley	X		
Big Spring and Big Arroyo Hills			
Bison Creek			
Black Mountain at Aspen Park		X	
Blanca Wetlands			X
Bobcat Ridge Hogback			
Buck Gulch			
Buffalograss Playas			
Buffmeyer Draw			
Bull Creek			
Button Rock Mountain			
Buzzard Creek			
Cactus Park at Triangle Mesa			
Calamity Ridge	X	X	X
Camp Gulch			
Canon City Hogback			
Cap Rock Preserve			
Cascade Creek East			
Case Reservoir Bluffs			
Cathedral Bluffs		X	X
Cave Basin Lakes			
Cedar Creek			
Cedar Hill			

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B2 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan	Designated Natural Area	ACEC or RNA
Cedaredge			
Cherokee Park			
Cherokee Park South			
Cheyenne Canyon			
Chromo			
Cimarron			
Cimarron State Wildlife Area			
Clear Creek			
Clear Creek to Golden			
Coffintop Mountain			
Cold Spring Mountain			
Colona Mountain			
Columbine Pass/Chicago Basin			
Conn Creek			
Copper Gulch			
Cordova Mesa			
Cotopaxi			
Cottonwood Creek Road			
Cougar Springs			
County Line			
Cow Ridge			
Coyote Wash			
Crater Lake			
Cumberland Ditch			
Curley Peak			
Dale Creek			
Deadman Creek-Western Sangres			
Deep Creek Uplands West			
Deer Creek East			
Devils Kitchen			
Disappointment Valley Northwest			
Dixon Creek			
Dolores-Norwood Road			
Dry Cedar Creek			
Dry Creek Basin			
Dry Fork Kimball Creek			
Dry Fork Piceance Creek			
Duck Lake			

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B2 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan	Designated Natural Area	ACEC or RNA
East Beaver Creek			
East Carrizo Creek			
East Fork Parachute Creek			
East Fork San Juan River			
East Lost Park		X	
East of Young Gulch			
East Paradox Creek			
East Schwachheim Creek			
Endlich Mesa			
Escalante Canyon		X	X
Fairview		X	X
Fairview Peak			
Flat Top to Bostwick Park			
Forest Road 251			
Fourmile Creek-Fremont County			
FR 121 at Big Creek			
Freezeout Creek			
Fremont's Fen			
Fruita and Monument Canyons			
Garden Park Fossil	X	X	X
Geneva Park			
Gift Creek at Hawk			
Gilligan's Island			
Glacier Basin			
Green River			
Grenada Trail			
Greyrock Mountain			
Gunnison Gorge South Rim			X
Gunnison River			
Harrington Gulch			
Hay Gulch	X		
Hecla Junction			X
Hermit Park			
Highland Mary Lakes			
Highway 65 at Grand Mesa NF Boundary			
Horse Gulch	X		
Horseshoe Park			
Hotchkiss Hills			

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B2 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan	Designated Natural Area	ACEC or RNA
Huff			
Hwy 141 and 145 Junction			
Ice Lake Basin			
Imogene Pass			
Indian Creek Hogback			
Irish Canyon		X	X
James Creek			
Jefferson and Guernsey Creeks			
Ken Caryl Hogback Complex		X	
King Gulch			
Kinikin Road/Sunshine Road			
Kremmling	X		
La Manga Creek			
Lake Como			
Lands End			
Lasauses			X
Lawhead Gulch			
Lennox Mesa			
Lily Mountain			
Lime Mesa			
Little Angry Creek			
Little Coal Creek			
Little Gypsum Valley			
Locke Park			
Lone Pine Creek North			X
Lonetree			
Long Gulch at Platte River Mountains			
Lost Park		X	
Lovers Leap			
Lower Greasewood Gulch		X	X
Luning Promontory			
Lykins Gulch			
Mailbox Park			
Maxwell Ranch South			
McCabe Creek			
McClure Pass			
McIntyre Canyon			
McIntyre Hills			X

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B2 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan	Designated Natural Area	ACEC or RNA
Meadow Springs Ranch			
Mesa Verde Aqueduct			
Mesa Verde Entrance			
Michigan River at Jackson County Airport			
Middle Two Butte Creek			
Mineral Basin			
Miners Creek			
Mishak Lakes		X	
Moose Mountain			
Morfield and Prater Canyons			
Mount Audubon			
Mount Bellview		X	X
Mount Flora			
Mount Logan Road		X	
Mud Canyon			X
Mud Creek			
Mustang Creek			
Navajo Basin			
Niwot Ridge			
North Boulder Grasslands			
North Creede			
North Fork South Platte			
North Mesa Community Hall			
North Saint Vrain			X
North Sand Dunes			
Old Fall River Road			
Old Grand Mesa Road			
Ou Creek			
Pahlone Slopes			
Parachute Creek			
Paradox Valley North			
Park Creek Hogback		X	
Pasture 10A North			
Peach Valley			X
Phantom Canyon			
Phantom Canyon of Eightmile Creek			X
Piceance Creek		X	X
Pine Park Reservoir			

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B2 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan	Designated Natural Area	ACEC or RNA
Pine/Piedra Stock Trail			
Poitrey Hills			
Pool Creek			
Pot Creek			
Prospect Park			
Rabbit Valley		X	X
Rat Creek Pond			
Raven Ridge		X	X
Red Dirt Creek at Hinman Reservoir	X		
Revenue Mountain to Landslide Peak			
Reynolds Ranch			
Ritchie Gulch Upland			
Roaring Fork River at Carbondale			
Robb Cemetery			
Rock Creek	X		
Rock Outcrop West of Mason Creek			
Rolling Mountain			
Roubideau Creek			
Royal Gorge			X
Ruby Mountain			X
Russell Lakes			
Sacramento Creek			
San Luis Lakes		X	
Sand Canyon at McElmo			
Seven Hermits			
Sheep Mountain in San Juans			
Shell Rock Canyon		X	
Silver Pick Basin			
Sinbad Valley			
Six and Fifty Reservoir			
Skaguay Reservoir			
Slick Rock Hill			
Snowdon Peak			
South Boulder Creek		X	
South Canal		X	X
South Saint Vrain			
South Tarryall Peak			
Spring Creek at Greenie Mountain			

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B2 Important Plant Areas For Map of IPAs see Part 4, Figure 4	Conservation Action Plan	Designated Natural Area	ACEC or RNA
Spring Creek Basin			
Springdale			
Sterling Place			
Stollsteimer Creek North	X		
Stony Pass			
Stout Creek			
Stuntz Reservoir			
Taylor Canyon			
Taylor Canyon at San Juan River			
Taylor Canyon at Taylor Park Reservoir			
Taylor Pass			
Taylor River at Almont			
Tecolote Creek Springs			
Tenderfoot Hill			
The Ant Hill			
The Castle			
The Crown			
Threemile Creek			
Timber Gulch			
Turkey Mountain			
Turkey Roost			
Two Butte Creek			
Two Buttes East		X	
Unnamed Tributary to Badger Creek at Howard			
Upper Fourmile Creek			
Upper Medano Creek			
Wells Gulch			
West Mud Creek			
West Silver Mesa			
Wildcat Gulch			
Williams Creek Campground			
Yellowjacket Pass			
Zenobia Peak			

APPENDIX D: COLORADO DESIGNATED NATURAL AREAS CONSERVING IMPORTANT PLANT AREAS

List of Designated Natural Areas Conserving Portions of Important Plant Areas
Antero-Salt Creek
Blue Mountain-Little Thompson Fault
Colorado Tallgrass Prairie
Dakota Hogback
Deer Gulch
Droney Gulch
Duck Creek
Dudley Bluffs
East Lost Park
East Sand Dunes
Escalante Canyon
Fairview
Garden Park Fossil Locality
Gateway Palisade
Geneva Basin Iron Fens
Gothic
Hoosier Ridge
Indian Spring
Irish Canyon
Ken-Caryl Ranch
Limestone Ridge
Lower Greasewood
Mexican Cut
Miramonte
Mishak Lakes
Mount Callahan & Logan Wash Mine
North Park
Park Creek Hogback
Pyramid Rock
Rabbit Valley
Raven Ridge
Ryan Gulch
Shell Duck Creek

List of Designated Natural Areas Conserving Portions of Important Plant Areas
Shell Rock
South Beaver Creek
South Boulder Creek
South Cathedral Bluffs
Staunton
Treasurevault Mtn.
Two Buttes
Wacker Ranch
Wheeler Geologic
Yanks Gulch/Upper Greasewood Creek

APPENDIX E: 2011 COLORADO RARE PLANT CONSERVATION INITIATIVE MEMBERS

David Anderson, Colorado Natural Heritage Program (CNHP)
Rob Billerbeck, Colorado Natural Areas Program (CNAP)
Leo P. Bruederle, University of Colorado Denver (UCD)
Lynn Cleveland, Colorado Federation of Garden Clubs (CFGC)
Carol Dawson, Bureau of Land Management (BLM)
Michelle DePrenger-Levin, Denver Botanic Gardens (DBG)
Brian Elliott, Environmental Consulting
Mo Ewing, Colorado Open Lands (COL)
Tom Grant, Colorado State University (CSU)
Jill Handwerk, Colorado Natural Heritage Program (CNHP)
Tim Hogan, University of Colorado Herbarium (COLO)
Steve Kettler, U.S. Fish and Wildlife Service (USFWS)
Andrew Kratz, U.S. Forest Service (USFS)
Sarada Krishnan, Colorado Native Plant Society (CoNPS), Denver Botanic Gardens
Brian Kurznel, Colorado Natural Areas Program
Eric Lane, Colorado Department of Agriculture (CDA)
Paige Lewis, The Nature Conservancy (TNC)
Ellen Mayo, U.S. Fish and Wildlife Service
Mitchell McGlaughlin, University of Northern Colorado (UNC)
Jennifer Neale, Denver Botanic Gardens
Betsy Neely, The Nature Conservancy
Ann Oliver, The Nature Conservancy
Steve Olson, U.S. Forest Service
Susan Spackman Panjabi, Colorado Natural Heritage Program
Jeff Peterson, Colorado Department of Transportation (CDOT)
Josh Pollock, Center for Native Ecosystems (CNE)
Nicola Ripley, Betty Ford Alpine Gardens (BFAG)
Erin Robertson, Center for Native Ecosystems
Renee Rondeau, Colorado Natural Heritage Program
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Carol Till, Rocky Mountain Society of Botanical Artists (RMSBA)
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Colorado Natural Heritage Program

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Colorado Natural Areas Program

6060 Broadway, Denver, CO 80203; www.parks.state.co.us

Colorado Parks and Wildlife

317 West Prospect Road, Fort Collins, CO 80526 www.cpw.state.co.us



Ipomopsis polyantha, Pagosa skyrocket
By David G. Anderson



Appendix B: Invertebrates

This appendix contains information on non-mollusk invertebrates that have been identified by recognized experts as SGCN in Colorado (Table B-1). Information on habitats, threats, and conservation actions is needed, and monitoring efforts are sorely lacking for invertebrate species. Many of the invertebrate SGCN are not represented in Tables B-2 and B-3 due to lack of data. With the exception of mollusks, CPW does not have statutory authority over invertebrate species. Thus, we must rely upon our partners to fill these data gaps.

Invertebrate Species of Greatest Conservation Need

Table B-1. Invertebrate SGCN.

All species on this list are Tier 2 SGCN. Legend: **Federal Listing:** **LE** – listed Endangered; **LT** – listed Threatened; **C** – Candidate. **Agency Sensitive:** **BLM** – Bureau of Land Management; **USFS** – U.S. Forest Service. **NatureServe Global/State Status:** **1** – critically imperiled; **2** – imperiled; **3** – vulnerable; **4** – apparently secure, but with cause for long-term concern; **5** – demonstrably secure; **T** – subspecies status; **Q** – taxonomic uncertainty; **NR** – not ranked.

<i>Species</i>	Common Name	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	CO's Contribution to Overall Conservation	Urgency of Conservation Action	Ability to Implement Effective Conservation Actions	Ecological Value of the Species	NatureServe G-Rank	CNHP/NatureServe S-Rank	Declining Trend
ARACHNIDS												
<i>Hypochilus bonneti</i>	A lampshade spider									GNR	SNR	
INSECTS: BEETLES												
<i>Amblyderus weneri</i>	Great Sand Dunes anthicid beetle									G1?	S1	
<i>Cicindela theatina</i>	San Luis Dunes tiger beetle									G1	S1	
INSECTS: BUMBLEBEES												
<i>Bombus fervidus</i>	Yellow bumblebee									G4?	SNR	
<i>Bombus fraternus</i>	Southern plains bumblebee									G4	SNR	X
<i>Bombus morrisoni</i>	Morrison bumblebee									G4G5	SNR	X
<i>Bombus occidentalis</i>	Western bumblebee									G4	SNR	
<i>Bombus pensylvanicus</i>	American bumblebee									G3G4	SNR	
<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee									GU		

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<i>Species</i>	Common Name	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	CO's Contribution to Overall Conservation	Urgency of Conservation Action	Ability to Implement Effective Conservation Actions	Ecological Value of the Species	NatureServe G-Rank	CNHP/NatureServe S-Rank	Declining Trend
INSECTS: BUTTERFLIES, SKIPPERS, & MOTHS												
<i>Agapema homogena</i>	Rocky Mountain agapema									G4	S2	
<i>Anisota oslari</i>	Oslar's oakworm moth									G2G4	S1	
<i>Atrytone arogos</i>	Arogos skipper									G3	S2	
<i>Boloria improba acrocnema</i>	Uncompahgre fritillary	LE								G5 T1T2	S1	
<i>Callophrys comstocki</i>	Comstock's hairstreak									G3G4	S1	
<i>Callophrys mcfarlandi</i>	Sandia hairstreak									G4	S1	
<i>Callophrys mossii schryveri</i>	Moss's elfin									G4 T4	S2S3	
<i>Celastrina humulus</i>	Hops feeding azure									G2G3	S2	
<i>Coloradia luskii</i>	Lusk's pinemoth									G4	S1?	
<i>Danaus plexippus</i>	Monarch butterfly									G5	S5	
<i>Erynnis martialis</i>	Mottled duskywing									G3	S2S3	
<i>Euphilotes rita coloradensis</i>	Colorado blue									G3G4 T2T3	S2	
<i>Euphilotes rita emmeli</i>	Desert buckwheat blue									G3G4 T2	S1	
<i>Euphilotes spaldingi</i>	Spalding's blue									G3G4	S2S3	
<i>Euphyes bimacula</i>	Two-spotted skipper									G4	S2	
<i>Euproserpinus wiesti</i>	Wiest's sphinx moth									G3G4	S2	
<i>Eurystrymon favonius ontario</i>	Northern hairstreak									G4 T4	S1	
<i>Hemileuca neumoegeni</i>	A Buckmoth									G4	S1	
<i>Hesperia leonardus montana</i>	Pawnee montane skipper	LT				x				G4 T1	S1	
<i>Hesperia ottoe</i>	Ottoe skipper			x						G3G4	S2	
<i>Incisalia fotis</i>	Early elfin									G3G4	S2S3	
<i>Polites rhesus</i>	Rhesus skipper									G4	S2S3	
<i>Proserpinus flavofasciata</i>	Yellow-banded day sphinx									G4	S1	
<i>Pyrgus xanthus</i>	Xanthus skipper									G3G4	S3	
<i>Sagenosoma elsa</i>	A sphinx moth									G4	S1?	
<i>Speyeria idalia</i>	Regal fritillary			x						G3	S1	
<i>Speyeria nokomis nokomis</i>	Great Basin silverspot butterfly			x	x					G3T1	S1	
INSECTS: CADDISFLIES												
<i>Gumaga griseola</i>	Bushtailed Caddisfly									G5	S1	
<i>Ochrotrichia susanae</i>	Susan's purse-making caddisfly			x						G2	S2	

Colorado's 2015 State Wildlife Action Plan

<i>Species</i>	Common Name	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	CO's Contribution to Overall Conservation	Urgency of Conservation Action	Ability to Implement Effective Conservation Actions	Ecological Value of the Species	NatureServe G-Rank	CNHP/NatureServe S-Rank	Declining Trend
<i>Ochrotrichia trapoiza</i>	Caddisfly									G3	S1	
INSECTS: DRAGONFLIES & DAMSELFLIES												
<i>Argia alberta</i>	Paiute dancer									G4	S1S2	
<i>Calopteryx aequabilis</i>	River Jewelwing									G5	SH	
<i>Calopteryx maculata</i>	Ebony jewelwing									G5	S1	
<i>Cordulegaster dorsalis</i>	Pacific Spiketail									G5	S1	
<i>Dromogomphus spoliatus</i>	Flag-tailed Spinyleg									G4G5		
<i>Enallagma vesperum</i>	Vesper Bluet									G5	S1	
<i>Epitheca petechialis</i>	Dot-winged baskettail									G4	SNR	
<i>Erpetogomphus compositus</i>	White-belted Ringtail									G5		
<i>Erythemis vesiculosa</i>	Great Pondhawk									G5	SNR	
<i>Lestes alacer</i>	Plateau Spreadwing									G5		
<i>Leucorrhinia glacialis</i>	Crimson-winged Whiteface									G5		
<i>Libellula nodisticta</i>	Hoary skimmer									G4	S1	
<i>Somatochlora ensigera</i>	Lemon-faced emerald									G4	S1	
<i>Somatochlora hudsonica</i>	Hudsonian emerald			x						G5	S2S3	
<i>Stylurus intricatus</i>	Brimstone clubtail									G4	S2	
<i>Sympetrum madidum</i>	Red-veined meadowfly									G4	S1	
INSECTS: MAYFLIES												
<i>Acentrella parvula</i>	Small Minnow Mayfly									G5	SNR	
<i>Acerpenna pygmaea</i>	Tiny Blue-Winged Olive									G5	S1	
<i>Ametropus neavei</i>	Mayfly, spp.									G4	S2	
<i>Apobaetis etowah</i>	Small Minnow Mayfly									G5	SNR	
<i>Baetis brunneicolor</i>	Small Minnow Mayfly									G5		
<i>Camelobaetidius warreni</i>	Small Minnow Mayfly									G5	S1	
<i>Ephemerella apopsis</i>	Spiny Crawler Mayfly									G1Q	S1	
<i>Homoeneurina alleni</i>												
<i>Labiobaetis apache</i>	Small Minnow Mayfly									G4	S1	
<i>Lachlania saskatchewanensis</i>	Bushlegged Mayfly									G4	S2	
<i>Macdunnoa persimplex</i>	Flathead Mayfly									G4	S1	
<i>Neochoroterpes oklahoma</i>	Pronggill Mayfly									G5	S1	
<i>Plauditus cestus</i>	Small Minnow Mayfly									G5	SNR	
<i>Pseudiron centralis</i>	White Sand River Mayfly									G5	S2?	
<i>Rhithrogena flavianula</i>	Flathead Mayfly									G1G3	S1	
INSECTS: MYDAS FLIES												
<i>Nemomydas solitarius</i>	A mydas fly											

<i>Species</i>	Common Name	Federal Status	State Status	USFS Sensitive Species	BLM Sensitive Species	CO's Contribution to Overall Conservation	Urgency of Conservation Action	Ability to Implement Effective Conservation Actions	Ecological Value of the Species	NatureServe G-Rank	CNHP/NatureServe S-Rank	Declining Trend
INSECTS: STONEFLIES												
<i>Arsapnia [=Capnia] arapahoe</i>	Arapahoe snowfly	C		x		x				G1	S1	
<i>Capnia nelsoni</i>	Nelson's snowfly									GNR	SNR	
<i>Mesocapnia frisoni</i>	Plains snowfly									G5	S1	
<i>Pteronarcys californica</i>	Giant stonefly									G5	SNR	

Habitats, Threats, and Conservation Actions

Table B-2 presents status and trend, habitats and distribution, threats, and prioritized conservation actions for non-mollusk invertebrates, where that information is available. Species for which information is not available are not included in the table. See Appendix E for a key to the distribution field.

Table B-2. Species of Greatest Conservation Need Threats and Conservation Actions

Other Invertebrates.

Sorted by Taxonomic Group, then by Scientific Name.

Tier 2		Arachnids			
A lampshade spider	Population Status and Trend	Distribution	Type	Habitat	Primary
	Low X Unknown X	Southern Rocky Mountains	P	Cliffs and Canyons	<input checked="" type="checkbox"/>
<i>Hypochilus bonneti</i>					
Tier 2 Arachnids					
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H	
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H	
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution and small local population size)	1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)	H	

Tier 2		Insects			
Rocky Mountain agapema	Population Status and Trend	Distribution	Type	Habitat	Primary
	Unknown X Unknown X	Front Range Southern Rocky Mountains	P O	Upland Shrub Lodgepole Pine Mixed Conifer Ponderosa Pine	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<i>Agapema homogena</i>					
Tier 2 Insects					
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority	
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H	
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation)	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	L	

Great Sand Dunes anthicid beetle	Population Status and Trend	Distribution	Type	Habitat	Primary
	Low X Unknown X	Southern Rocky Mountains	P	Sand Dunes	<input checked="" type="checkbox"/>
<i>Amblyderus weneri</i>					
Tier 2 Insects					
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority	
07.2 Dams & Water Management/Use	Water use (de-watering of streams, groundwater pumping, surface water diversions)	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	H	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H	
06.1 Recreational Activities	Non-motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M	
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	L	

Table B-2 - Continued.

Mayfly, spp.

Population Status and Trend		Distribution	Type	Habitat	Primary		
Unknown	X	Unknown	X	Utah High Plateau Wyoming Basin	P p	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>

Ametropus neavei

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	M
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	M
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)	2.1 Site/Area Management	Implement compatible grazing practices	M
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	M

Oslar's oakworm moth

Population Status and Trend		Distribution	Type	Habitat	Primary		
Unknown	X	Unknown	X	Colorado Plateau	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>

Anisota oslari

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H

Paiute dancer

Population Status and Trend		Distribution	Type	Habitat	Primary		
Medium	X	Declining	X	Central Shortgrass Prairie	P	Eastern Plains Rivers Eastern Plains Streams	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>

Argia alberta

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Water use, management	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	H
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	H
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation)	2.1 Site/Area Management	Implement compatible grazing practices	M
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	M
09.3 Agricultural & Forestry Effluents	Nutrient loads	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M

Table B-2 - Continued.

Arapahoe snowfly	Population Status and Trend		Distribution	Type	Habitat	Primary
	Low	D				
			Front Range	P	Mountain Streams	<input checked="" type="checkbox"/>
			Southern Rocky Mountains	P	Transition Streams	<input type="checkbox"/>

Arsapnia arapahoe

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	H
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads, etc.)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.	H
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution and small local population size)	1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)	H

Arogos skipper	Population Status and Trend		Distribution	Type	Habitat	Primary
	Low	X				
			Front Range	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
			Southern Rocky Mountains	O	Mixed and Tallgrass Prairies	<input type="checkbox"/>

Atrytone arogos

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.	H
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	H
07.3 Other Ecosystem Modifications	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	H
09.3 Agricultural & Forestry Effluents	Altered native vegetation (seral stage imbalance)	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	M
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	M

Uncompahgre fritillary	Population Status and Trend		Distribution	Type	Habitat	Primary
	Low	X				
			Southern Rocky Mountains	P	Alpine Wetlands	<input checked="" type="checkbox"/>
						<input type="checkbox"/>

Boloria improba acrocneema

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Gathering	5.4 Compliance & Enforcement	Enforce hunting, fishing, collecting regulations	H
11.1 Habitat Shifting & Alteration	Habitat shifting and alteration due to climate change	2.3 Habitat & Natural Process Restoration	Reduce CO2 emissions	H
14.1 Scarcity (leading to inbreeding depression)	Non-motorized recreation	3.1 Species Management	Implement existing management/recovery plan	H
06.1 Recreational Activities	Scarcity (limited distribution)	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M

Table B-2 - Continued.

Yellow bumblebee		Population Status and Trend	Distribution	Type	Habitat	Primary
<i>Bombus fervidus</i>	Tier 2 Insects	Unknown Declining D Reference: Hatfield et al., IUCN assessment in prep.	Central Shortgrass Prairie		Agriculture	<input checked="" type="checkbox"/>
			Colorado Plateau		Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
			Front Range		Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
			Southern Rocky Mountains		Shortgrass Prairie	<input checked="" type="checkbox"/>
			Utah High Plateau			

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Habitat loss, fragmentation, and restriction of movement	1.2 Resource & Habitat Protection	Restore, create and preserve natural grassland habitats	H
01.2 Commercial & Industrial Areas	Habitat loss, fragmentation, and restriction of movement	1.2 Resource & Habitat Protection	Restore, create and preserve natural grassland habitats	H
02.1 Annual & Perennial Non-Timber Crops	Conversion in agricultural farmland from the use of nitrogen-fixing legumes to artificial fertilizers may decrease available forage	2.1 Site/Area Management	Promote farming practices that increase the abundance of nitrogen-fixing fallow (legumes)	H
02.3 Livestock Farming & Ranching	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural grassland habitats	H
07.1 Fire & Fire Suppression	Habitat loss	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural grassland habitats	H
08.1 Invasive Non-Native/Alien Species	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Avoid introduction of non-native honey bees, commercial bumble bees, and mason bees into high-quality native bee habitat	H
08.4 Pathogens	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Avoid importation of non-native species, and use only pathogen free animals	H
09.3 Agricultural & Forestry Effluents	Pesticides	4.3 Awareness & Communications	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
03.2 Mining & Quarrying	Habitat loss, fragmentation, and restriction of movement	1.2 Resource & Habitat Protection	Restoration, creation and preservation Restore, create and preserve natural grassland habitats	L
11.1 Habitat Shifting & Alteration	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L
11.2 Droughts	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L
11.3 Temperature Extremes	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L
11.4 Storms & Flooding	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L

Table B-2 - Continued.

Southern plains bumblebee		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 2 Insects	<i>Bombus fraternus</i>	Unknown Declining D See Hatfield, R., Jepsen, S., Thorp, R., Richardson, L. & S. Colla. 2014. <i>Bombus fraternus</i> . The IUCN Red List of Threatened Species. Version 2014.3, www.iucnredlist.org	Central Shortgrass Prairie	P	Agriculture	<input checked="" type="checkbox"/>
					Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
					Reservoirs and Shorelines	<input checked="" type="checkbox"/>
					Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
					Shortgrass Prairie	<input checked="" type="checkbox"/>
					Wetlands	<input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Promote farming practices that increase of nitrogen-fixing fallow (legumes) and other pollinator-friendly plants along field margins	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural grassland habitats	H		
02.1 Annual & Perennial Non-Timber Crops	Pesticides	5.3 Private Sector Standards & Codes	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H		
08.1 Invasive Non-Native/Alien Species	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Avoid introduction of non-native honey bees, commercial bumble bees, and mason bees into high-quality native bee habitat	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M		
13.4 Population status unknown	Population status unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M		

Table B-2 - Continued.

Morrison bumblebee		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 2	Insects	Unknown Declining D See Hatfield, R., Jepsen, S., Thorp, R., Richardson, L. & Colla, S. 2014. <i>Bombus morrisoni</i> . The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org	Central Shortgrass Prairie		Desert Shrub	<input checked="" type="checkbox"/>
			Colorado Plateau		Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
			Front Range		Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
			Southern Rocky Mountains		Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
			Utah High Plateau		Sagebrush	<input checked="" type="checkbox"/>
			Utah-Wyoming Rocky Mountains		Shortgrass Prairie	<input checked="" type="checkbox"/>
			Wyoming Basin		Upland Shrub	<input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Promote farming practices that increase of nitrogen-fixing fallow (legumes) and other pollinator-friendly plants along field margins	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H		
02.1 Annual & Perennial Non-Timber Crops	Pesticides	5.3 Private Sector Standards & Codes	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H		
08.1 Invasive Non-Native/Alien Species	Non-native bees	2.2 Invasive/Problematic Species Control	Avoid introduction of non-native honey bees, commercial bumble bees, and mason bees into high-quality native bee habitat	H		
08.1 Invasive Non-Native/Alien Species	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Avoid honey bee introduction to high-quality native bee habitat	H		
08.4 Pathogens	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Minimize exposure of wild bees to diseases transferred from managed bees	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M		
13.4 Population status unknown	Population status unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M		

Table B-2 - Continued.

Western bumblebee		Population Status and Trend	Distribution	Type	Habitat	Primary
<i>Bombus occidentalis</i> Tier 2 Insects	Unknown	Unknown	Southern Rocky Mountains	P	Agriculture	<input checked="" type="checkbox"/>
	Threats based on rangewide assessment; Colorado-specific status is unknown. See Xerces Society 2008 status review for additional information. IUCN assessment in prep.		Utah-Wyoming Rocky Mountains		Alpine	<input checked="" type="checkbox"/>
					Desert Shrub	<input checked="" type="checkbox"/>
					Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
					Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
					Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
					Reservoirs and Shorelines	<input checked="" type="checkbox"/>
					Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
					Sagebrush	<input checked="" type="checkbox"/>
					Shortgrass Prairie	<input checked="" type="checkbox"/>
					Upland Shrub	<input checked="" type="checkbox"/>
					Wetlands	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Habitat loss, fragmentation, and restriction of movement	1.1 Site/Area Protection	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
01.1 Housing & Urban Areas	Pesticides	2.1 Site/Area Management	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Promote farming practices that increase of nitrogen-fixing fallow (legumes) and other pollinator-friendly plants along field margins	H
02.1 Annual & Perennial Non-Timber Crops	Pesticides	2.1 Site/Area Management	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H
02.1 Annual & Perennial Non-Timber Crops	Potential for loss of pollinator-friendly cover and destruction of nests	1.2 Resource & Habitat Protection	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
02.3 Livestock Farming & Ranching	Potential for depleting food sources and destruction of nests	2.1 Site/Area Management	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
05.3 Logging & Wood Harvesting	Increased siltation in runoff has the potential to alter meadow ecosystems and disrupt habitat	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
07.1 Fire & Fire Suppression	Loss of meadow habitats from fire suppression and forest encroachment	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
08.1 Invasive Non-Native/Alien Species	Non-native bees	2.2 Invasive/Problematic Species Control	Avoid introduction of non-native honey bees, commercial bumble bees, and mason bees into high-quality native bee habitat	H
08.1 Invasive Non-Native/Alien Species	Weeds outcompeting native nectar sources	2.2 Invasive/Problematic Species Control	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
08.4 Pathogens	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Minimize exposure of wild bees to diseases transferred from managed bees	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
13.4 Population status unknown	Population status unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M

Table B-2 - Continued.

13.5 Population trend unknown	Population trend unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
06.1 Recreational Activities	Recreation (such as off-road vehicle use) has the potential to alter meadow ecosystems and disrupt habitat	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
11.1 Habitat Shifting & Alteration	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L

Table B-2 - Continued.

American bumblebee		Population Status and Trend	Distribution	Type	Habitat	Primary
Tier 2	Insects	Unknown Declining D Reference: Hatfield et al., IUCN assessment in prep.	Central Shortgrass Prairie	P	Agriculture	<input checked="" type="checkbox"/>
			Front Range	P	Foothill and Mountain	<input checked="" type="checkbox"/>
			Southern Rocky Mountains	P	Grasslands	<input checked="" type="checkbox"/>
			Colorado Plateau	O	Mixed and Tallgrass Prairies Shortgrass Prairie	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority		
01.1 Housing & Urban Areas	Habitat loss, fragmentation, and restriction of movement	1.1 Site/Area Protection	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H		
01.2 Commercial & Industrial Areas	Habitat loss, fragmentation, and restriction of movement	1.2 Resource & Habitat Protection	Restore, create and preserve natural grassland habitats	H		
02.1 Annual & Perennial Non-Timber Crops	Conversion in agricultural farmland from the use of nitrogen-fixing legumes to artificial fertilizers may decrease available forage	2.1 Site/Area Management	Promote farming practices that increase the abundance of nitrogen-fixing fallow (legumes)	H		
02.1 Annual & Perennial Non-Timber Crops	Pesticides	2.1 Site/Area Management	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H		
02.3 Livestock Farming & Ranching	Potential for depleting food sources and destruction of nests	2.1 Site/Area Management	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H		
03.2 Mining & Quarrying	Habitat loss, fragmentation, and restriction of movement	1.2 Resource & Habitat Protection	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H		
07.1 Fire & Fire Suppression	Loss of meadow habitats from fire suppression and forest encroachment	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H		
08.1 Invasive Non-Native/Alien Species	Non-native bees	2.2 Invasive/Problematic Species Control	Avoid introduction of non-native honey bees, commercial bumble bees, and mason bees into high-quality native bee habitat	H		
08.4 Pathogens	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Minimize exposure of wild bees to diseases transferred from managed bees	H		
09.3 Agricultural & Forestry Effluents	Pesticides	4.3 Awareness & Communications	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M		
11.1 Habitat Shifting & Alteration	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L		
11.2 Droughts	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L		
11.3 Temperature Extremes	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L		
11.4 Storms & Flooding	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L		

Table B-2 - Continued.

Suckley cuckoo bumblebee		Population Status and Trend	Distribution	Type	Habitat	Primary
<i>Bombus suckleyi</i> Tier 2 Insects	Unknown	Declining D	Southern Rocky Mountains	P	Agriculture	<input checked="" type="checkbox"/>
	Reference: Hatfield et al., IUCN assessment in prep.		Colorado Plateau	O	Alpine	<input checked="" type="checkbox"/>
			Front Range	O	Desert Shrub	<input checked="" type="checkbox"/>
					Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
					Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
					Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
					Reservoirs and Shorelines	<input checked="" type="checkbox"/>
					Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
					Sagebrush	<input checked="" type="checkbox"/>
					Shortgrass Prairie	<input checked="" type="checkbox"/>
					Upland Shrub	<input checked="" type="checkbox"/>
					Wetlands	<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Habitat loss, fragmentation, and restriction of movement	1.1 Site/Area Protection	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
01.1 Housing & Urban Areas	Pesticides	2.1 Site/Area Management	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Promote farming practices that increase of nitrogen-fixing fallow (legumes) and other pollinator-friendly plants along field margins	H
02.1 Annual & Perennial Non-Timber Crops	Pesticides	2.1 Site/Area Management	Restrict pesticide use, especially neonicotinoids, on or near suitable habitat, particularly while treated plants are in flower; reduce use of cosmetic applications, particularly on high use trees	H
02.1 Annual & Perennial Non-Timber Crops	Potential for loss of pollinator-friendly cover and destruction of nests	1.2 Resource & Habitat Protection	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
02.3 Livestock Farming & Ranching	Potential for depleting food sources and destruction of nests	2.1 Site/Area Management	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
05.3 Logging & Wood Harvesting	Increased siltation in runoff have the potential to alter meadow ecosystems and disrupt habitat	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
07.1 Fire & Fire Suppression	Loss of meadow habitats from fire suppression and forest encroachment	2.3 Habitat & Natural Process Restoration	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
08.1 Invasive Non-Native/Alien Species	Non-native bees	2.2 Invasive/Problematic Species Control	Avoid introduction of non-native honey bees, commercial bumble bees, and mason bees into high-quality native bee habitat	H
08.1 Invasive Non-Native/Alien Species	Weeds outcompeting native nectar sources	2.2 Invasive/Problematic Species Control	Restore, create and preserve natural high-quality habitats to include suitable forage, nesting and overwintering sites.	H
08.4 Pathogens	Potential spread of pests and disease by commercial bumble bee producers	2.2 Invasive/Problematic Species Control	Minimize exposure of wild bees to diseases transferred from managed bees	M
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M
13.4 Population status unknown	Population status unknown	8.0 Research & Monitoring	Research population parameters and/or monitor status	M

Table B-2 - Continued.

06.1 Recreational Activities	Recreation (such as off-road vehicle use) has the potential to alter meadow ecosystems and disrupt habitat	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
11.1 Habitat Shifting & Alteration	Potential for disruption of plant-pollinator relationships and alteration of nectar production	8.0 Research & Monitoring	Model habitat responses, including future distribution and effects of altered snow melt on meadows to identify areas for focusing conservation efforts	L

Comstock's hairstreak		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Stable	X	Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
						Utah High Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
								Mixed and Tallgrass Prairies	<input type="checkbox"/>
								Sagebrush	<input type="checkbox"/>

Callophrys comstocki
Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	H
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M

Sandia hairstreak		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Low	X	Unknown	X	Central Shortgrass Prairie	P	Shortgrass Prairie	<input checked="" type="checkbox"/>

Callophrys mcfarlandi
Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Avoid destruction of large tracts of native habitat (e.g., ski area development, sod-busting)	L

Moss's elfin		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Low	X	Declining	X	Front Range	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
								Ponderosa Pine	<input checked="" type="checkbox"/>
								Upland Shrub	<input checked="" type="checkbox"/>
								Transition Streams	<input type="checkbox"/>

Callophrys mossii schryveri
Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.	H
06.1 Recreational Activities	Non-motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M
01.3 Tourism & Recreation Areas	Recreation area developments	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
07.3 Other Ecosystem Modifications	Altered native vegetation (seral stage imbalance)	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	L

Table B-2 - Continued.

Nelson's snowfly		Population Status and Trend		Distribution	Type	Habitat	Primary
	Unknown	X	Unknown	X	Southern Rocky Mountains	Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
						Wetlands	<input type="checkbox"/>
<i>Capnia nelsoni</i>							
Tier 2 Insects							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
12.2 Lack of funding	Lack of funding			7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders		H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown			8.0 Research & Monitoring	Research population parameters and/or monitor status		H
14.1 Scarcity (leading to inbreeding depression)	Scarcity			1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)		H
Hops feeding azure		Population Status and Trend		Distribution	Type	Habitat	Primary
	Low	X	Declining	X	Front Range	P Transition Streams	<input checked="" type="checkbox"/>
<i>Celastrina humulus</i>							
Tier 2 Insects							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.		H
06.1 Recreational Activities	Non-motorized recreation			2.1 Site/Area Management	Manage public use to be compatible with biodiversity		H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		H
13.4 Population status unknown	Lack of data on population status unknown			8.0 Research & Monitoring	Research population parameters and/or monitor status		H
07.1 Fire & Fire Suppression	Altered fire regime			2.3 Habitat & Natural Process Restoration	Restore natural fire regime		M
08.1 Invasive Non-Native/Alien Species	Invasive plants			2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions		M
San Luis Dunes tiger beetle		Population Status and Trend		Distribution	Type	Habitat	Primary
	Low	X	Unknown	X	Southern Rocky Mountains	P Sand Dunes	<input checked="" type="checkbox"/>
<i>Cicindela theatina</i>							
Tier 2 Insects							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority
07.2 Dams & Water Management/Use	Water use (e.g., de-watering of streams, lowering of groundwater)			1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights to maintain adequate groundwater levels		H
07.2 Dams & Water Management/Use	Water use, management			5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development		H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		H
06.1 Recreational Activities	Non-motorized recreation			2.1 Site/Area Management	Manage public use to be compatible with biodiversity		M
06.1 Recreational Activities	OHV use			2.1 Site/Area Management	Manage public use to be compatible with biodiversity		M

Table B-2 - Continued.

Lusk's pinemoth	Population Status and Trend		Distribution	Type	Habitat	Primary
	Unknown	X				
<i>Coloradia luski</i>		X	Front Range		Ponderosa Pine	<input checked="" type="checkbox"/>
			Southern Rocky Mountains		Lodgepole Pine	<input type="checkbox"/>
					Mixed Conifer	<input type="checkbox"/>

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
08.2 Problematic Native Species	Habitat loss / degradation due to beetle kill	5.3 Private Sector Standards & Codes	Implement Best Management Practices for forestry	M
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	M
05.3 Logging & Wood Harvesting	Forest and woodland management	2.1 Site/Area Management	Implement compatible forest management practices	L

Monarch butterfly	Population Status and Trend		Distribution	Type	Habitat	Primary
	Unknown	X				
<i>Danaus plexippus</i>					Agriculture	<input checked="" type="checkbox"/>
					Shortgrass Prairie	<input checked="" type="checkbox"/>
					Wetlands	<input checked="" type="checkbox"/>

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	5.3 Private Sector Standards & Codes	Implement Best Management Practices for transportation projects	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	H
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	H
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M
11.1 Habitat Shifting & Alteration	Potential for phenology mismatch with host plants and nectar sources	2.3 Habitat & Natural Process Restoration	Maintain linkages and connectivity (e.g., wildlife over/under passes, habitat corridors, wildlife-friendly fences)	M
13.1 Complete distribution in Colorado unknown		8.0 Research & Monitoring		L

Table B-2 - Continued.

Dot-winged baskettail		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Medium	X	Unknown	X	Central Shortgrass Prairie	P	Wetlands <input checked="" type="checkbox"/>
<i>Epitheca petechialis</i>		This species has undergone a taxonomic revision and has been renamed <i>Epitheca costalis</i> (Dunkle 2000).						Eastern Plains Rivers <input type="checkbox"/>
Tier 2	Insects							Eastern Plains Streams <input type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	H			
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes		Implement Best Management Practices for water resource development	H			
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation, denuding of wetland vegetation)	2.1 Site/Area Management		Implement compatible grazing practices	H			
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H			
07.2 Dams & Water Management/Use	Water use (de-watering of streams)	1.2 Resource & Habitat Protection		Acquire water rights or instream flow rights	M			
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)	2.3 Habitat & Natural Process Restoration		Implement streambank or in-stream restoration/improvements	M			
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration		Reduce herbicide/pesticide use	M			
09.3 Agricultural & Forestry Effluents	Nutrient loads	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M			
Mottled duskywing		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Medium	X	Declining	X	Front Range	P	Upland Shrub <input checked="" type="checkbox"/>
<i>Erynnis martialis</i>						Central Shortgrass Prairie	O	Foothill and Mountain Grasslands <input type="checkbox"/>
Tier 2	Insects							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development		Develop partnerships among agencies, NGOs, and stakeholders	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H			
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration		Restore natural fire regime	L			
Colorado blue		Population Status and Trend		Distribution	Type	Habitat	Primary	
		Low	X	Declining	X	Central Shortgrass Prairie	P	Cliffs and Canyons <input checked="" type="checkbox"/>
<i>Euphilotes rita coloradensis</i>						Southern Rocky Mountains	O	Foothill and Mountain Grasslands <input checked="" type="checkbox"/>
Tier 2	Insects							Shortgrass Prairie <input checked="" type="checkbox"/>
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority			
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	H			
07.3 Other Ecosystem Modifications	Altered native vegetation (seral stage imbalance)	2.3 Habitat & Natural Process Restoration		Employ grazing as a tool for compatible vegetation cover, structure, composition	H			
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development		Develop partnerships among agencies, NGOs, and stakeholders	H			
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H			
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status	H			
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M			
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	1.2 Resource & Habitat Protection		Acquire conservation easement for habitat protection	M			

Table B-2 - Continued.

Desert buckwheat blue	Population Status		and Trend		Distribution	Type	Habitat	Primary
	Low	X	Declining	X				
	Low	X	Declining	X	Colorado Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
					Utah High Plateau	P		

Euphilotes rita emmeli

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
06.1 Recreational Activities	Motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	M
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	M
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	M

Spalding's blue	Population Status		and Trend		Distribution	Type	Habitat	Primary
	Medium	X	Unknown	X				
	Medium	X	Unknown	X	Colorado Plateau	P	Pinyon - Juniper	<input checked="" type="checkbox"/>
					Southern Rocky Mountains	O	Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
							Ponderosa Pine	<input type="checkbox"/>

Euphilotes spaldingi

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)	H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	L
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	L

Two-spotted skipper	Population Status		and Trend		Distribution	Type	Habitat	Primary
	Unknown	X	Declining	X				
	Unknown	X	Declining	X	Central Shortgrass Prairie	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
					Front Range		Wetlands	<input checked="" type="checkbox"/>
							Shortgrass Prairie	<input type="checkbox"/>

Euphyes bimacula

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations	Encourage use of Farm Bill programs	H
07.2 Dams & Water Management/Use	Water use, management	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	H
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation, denuding of wetland vegetation)	2.1 Site/Area Management	Implement compatible grazing practices	H
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
07.2 Dams & Water Management/Use	Water use (de-watering of streams)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	M
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	M
09.3 Agricultural & Forestry Effluents	Nutrient loads	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M

Table B-2 - Continued.

Wiest's sphinx moth	Population Status		Trend		Distribution	Type	Habitat	Primary
	Low	X	Unknown	X				
	Low	X	Unknown	X	Central Shortgrass Prairie	P	Sand Dunes	<input checked="" type="checkbox"/>
					Southern Rocky Mountains	O	Shortgrass Prairie	<input type="checkbox"/>

Euproserpinus wiesti

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
07.3 Other Ecosystem Modifications	Altered native vegetation (seral stage imbalance)	2.1 Site/Area Management	Implement compatible grazing practices	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	M

Northern hairstreak	Population Status		Trend		Distribution	Type	Habitat	Primary
	Low	X	Stable	X				
	Low	X	Stable	X	Central Shortgrass Prairie	P	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>
							Shortgrass Prairie	<input type="checkbox"/>

Eurystrymon favonius Ontario

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H

A buckmoth	Population Status		Trend		Distribution	Type	Habitat	Primary
	Unknown	X	Unknown	X				
	Unknown	X	Unknown	X	Utah High Plateau	P	Desert Shrub	<input checked="" type="checkbox"/>
					Wyoming Basin	O		

Hemileuca neuwoegeni

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	M

Pawnee montane skipper	Population Status		Trend		Distribution	Type	Habitat	Primary
	Low	D	Declining	D				
	Low	D	Declining	D	Southern Rocky Mountains	P	Ponderosa Pine	<input checked="" type="checkbox"/>
							Foothill and Mountain Grasslands	<input type="checkbox"/>

Hesperia leonardus montana

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	H
07.2 Dams & Water Management/Use	Water storage	6.3 Market Forces	Increase efficiency of water use	H
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)	3.1 Species Management	Implement existing management/recovery plan	H

Table B-2 - Continued.

Ottoa skipper		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Medium	X	Stable	X	Front Range	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
					Central Shortgrass Prairie	O	Oak and Mixed Mountain Shrublands	<input type="checkbox"/>
<i>Hesperia ottoe</i>								
Tier 2 Insects								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			2.3 Habitat & Natural Process Restoration	Avoid destruction of large tracts of native habitat (e.g., ski area development, sod-busting)	H		
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			2.1 Site/Area Management	Implement compatible grazing practices	H		
07.1 Fire & Fire Suppression	Altered fire regime			2.3 Habitat & Natural Process Restoration	Restore natural fire regime	H		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H		
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring	Research population parameters and/or monitor status	H		
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	M		
Early elfin		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Medium	X	Unknown	X	Colorado Plateau	Oak and Mixed Mountain Shrublands	<input checked="" type="checkbox"/>	
						Ponderosa Pine	<input checked="" type="checkbox"/>	
						Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>	
						Upland Shrub	<input checked="" type="checkbox"/>	
						Desert Shrub	<input type="checkbox"/>	
						Pinyon - Juniper	<input type="checkbox"/>	
<i>Incisalia fotis</i>								
Tier 2 Insects								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H		
13.4 Population status unknown	Lack of data on population status			8.0 Research & Monitoring	Research population parameters and/or monitor status	H		
12.2 Lack of funding	Lack of funding			7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	M		
07.1 Fire & Fire Suppression	Altered fire regime			2.3 Habitat & Natural Process Restoration	Restore natural fire regime	L		
08.1 Invasive Non-Native/Alien Species	Invasive plants			2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	L		
Bushlegged mayfly		Population Status and Trend		Distribution	Type	Habitat	Primary	
				Central Shortgrass Prairie		Colorado Plateau - Wyoming Basins Rivers	<input type="checkbox"/>	
				Utah-Wyoming Rocky Mountains		Eastern Plains Rivers	<input type="checkbox"/>	
<i>Lachlania saskatchewanensis</i>								
Tier 2 Insects								
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action	Priority		
09.3 Agricultural & Forestry Effluents	Nutrient loads			5.4 Compliance & Enforcement	Enforce state/federal/local pollution standards	L		

Table B-2 - Continued.

Hoary skimmer		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Medium	X	Stable	X	Central Shortgrass Prairie	P	Colorado Plateau - Wyoming Basins Streams	<input checked="" type="checkbox"/>
<i>Libellula nodisticta</i>		Habitat includes ponds, small streams and running springs in arid country.		Southern Rocky Mountains	P	Eastern Plains Streams	O	Lakes	<input checked="" type="checkbox"/>
Tier 2	Insects			Colorado Plateau	O	Wetlands			<input checked="" type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
07.2 Dams & Water Management/Use	Water use, management	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	M
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation)	2.1 Site/Area Management	Implement compatible grazing practices	M
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff, nutrient loads	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	M
09.3 Agricultural & Forestry Effluents	Nutrient loads	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M

Plains snowfly		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Declining	X	Southern Rocky Mountains	P	Transition Streams	<input checked="" type="checkbox"/>
<i>Mesocapnia frisoni</i>						Central Shortgrass Prairie	O	Eastern Plains Rivers	<input type="checkbox"/>
Tier 2	Insects							Eastern Plains Streams	<input type="checkbox"/>

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration	Improve erosion and excess sedimentation conditions	H
07.2 Dams & Water Management/Use	Water use, management	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	H
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	H
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H
07.3 Other Ecosystem Modifications	Altered native vegetation (seral stage imbalance)	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	M

Table B-2 - Continued.

Rhesus skipper		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	X	Declining	X	Central Shortgrass Prairie	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
					Front Range	P	Shortgrass Prairie	<input checked="" type="checkbox"/>
<i>Polites rhesus</i>					Colorado Plateau	O	Foothill and Mountain	<input type="checkbox"/>
Tier 2	Insects				Southern Rocky Mountains	O	Grasslands	

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection	H
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	2.3 Habitat & Natural Process Restoration	Avoid destruction of large tracts of native habitat (e.g., ski area development, sod-busting)	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution and small local population size)	1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)	H
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	M

Yellow-banded day sphinx		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Unknown	X	Unknown	X	Southern Rocky Mountains	P	Foothill and Mountain Grasslands	<input checked="" type="checkbox"/>
<i>Proserpinus flavofasciata</i>								
Tier 2	Insects							

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H

Giant stonefly		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Unknown	X	Unknown	X	Southern Rocky Mountains	P		<input type="checkbox"/>
<i>Pteronarcys californica</i>								
Tier 2	Insects							

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority

Table B-2 - Continued.

Xanthus skipper		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	X	Declining	X	Front Range	P	Foothill and Mountain	<input checked="" type="checkbox"/>
					Southern Rocky Mountains	P	Grasslands	
					Central Shortgrass Prairie	O	Aspen	<input type="checkbox"/>
					Colorado Plateau	O	Mixed Conifer	<input type="checkbox"/>
							Pinyon - Juniper	<input type="checkbox"/>
							Ponderosa Pine	<input type="checkbox"/>

Pyrgus xanthus
Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.1 Fire & Fire Suppression	Altered fire regime	2.3 Habitat & Natural Process Restoration	Restore natural fire regime	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
08.1 Invasive Non-Native/Alien Species	Invasive plants	2.2 Invasive/Problematic Species Control	Control non-native plants using accepted techniques appropriate to site-specific conditions	M
06.1 Recreational Activities	Motorized and non-motorized recreation	2.1 Site/Area Management	Manage public use to be compatible with biodiversity	L
07.3 Other Ecosystem Modifications	Altered native vegetation (seral stage imbalance)	2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition	L

A sphinx moth		Population Status and Trend		Distribution	Type	Habitat	Primary
	Unknown	X	Unknown	X	Central Shortgrass Prairie	P	<input type="checkbox"/>
					Colorado Plateau	P	

Sagenosoma elsa

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development	Develop partnerships among agencies, NGOs, and stakeholders	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
13.2 Critical life history/habitat components unknown	Habitat affinities unknown	8.0 Research & Monitoring	Research critical life history/habitat components	H
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring	Research population parameters and/or monitor status	H

Lemon-faced emerald		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	X	Unknown	X	Front Range	P	Eastern Plains Streams	<input checked="" type="checkbox"/>
					Central Shortgrass Prairie	O		

Somatochlora ensigera

Tier 2 Insects

General Threat	Specific Threat	General Conservation Action	Specific Conservation Action	Priority
07.2 Dams & Water Management/Use	Water use (e.g., de-watering of streams)	5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development	H
07.2 Dams & Water Management/Use	Water use, management	1.2 Resource & Habitat Protection	Acquire water rights or instream flow rights	H
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)	2.3 Habitat & Natural Process Restoration	Implement streambank or in-stream restoration/improvements	H
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown	8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area deforestation)	2.1 Site/Area Management	Implement compatible grazing practices	M
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	5.2 Policies & Regulations	Encourage use of Farm Bill and other incentive programs	M
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff	2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use	M
09.3 Agricultural & Forestry Effluents	Nutrient loads	5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production	M

Table B-2 - Continued.

Regal fritillary		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	X	Declining	X	Central Shortgrass Prairie	P	Mixed and Tallgrass Prairies	<input checked="" type="checkbox"/>
					Front Range	O	Shortgrass Prairie	<input checked="" type="checkbox"/>
<i>Speyeria idalia</i>							Foothill and Mountain Grasslands	<input type="checkbox"/>
Tier 2	Insects						Wetlands	<input type="checkbox"/>
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority	
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland			2.3 Habitat & Natural Process Restoration	Avoid destruction of large tracts of native habitat (e.g., ski area development, sod-busting)		H	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		H	
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		M	
02.3 Livestock Farming & Ranching	Incompatible timing, intensity, duration of grazing or improved range			2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition		M	
07.3 Other Ecosystem Modifications	Altered native vegetation (seral stage imbalance)			2.3 Habitat & Natural Process Restoration	Employ grazing as a tool for compatible vegetation cover, structure, composition		M	
05.1 Control of Nuisance Species & Collecting Terrestrial Animals	Gathering			5.4 Compliance & Enforcement	Enforce wildlife and habitat protection laws		L	
07.1 Fire & Fire Suppression	Altered fire regime			2.3 Habitat & Natural Process Restoration	Restore natural fire regime		L	
09.3 Agricultural & Forestry Effluents	Herbicide/pesticide spraying or runoff			2.3 Habitat & Natural Process Restoration	Reduce herbicide/pesticide use		L	
Great Basin silverspot butterfly		Population Status and Trend		Distribution	Type	Habitat	Primary	
	Low	X	Declining	X	Colorado Plateau		Riparian Woodlands and Shrublands	<input checked="" type="checkbox"/>
					Southern Rocky Mountains		Wetlands	<input checked="" type="checkbox"/>
					Utah High Plateau		Colorado Plateau - Wyoming Basins Streams	<input type="checkbox"/>
<i>Speyeria nokomis nokomis</i>								
Tier 2	Insects							
General Threat	Specific Threat			General Conservation Action	Specific Conservation Action		Priority	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			1.2 Resource & Habitat Protection	Acquire conservation easement for habitat protection		H	
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development			5.3 Private Sector Standards & Codes	Implement Best Management Practices for urban development, landscaping, etc.		H	
07.2 Dams & Water Management/Use	Water use, management			5.3 Private Sector Standards & Codes	Implement Best Management Practices for water resource development		H	
14.1 Scarcity (leading to inbreeding depression)	Scarcity (limited distribution)			1.2 Resource & Habitat Protection	Establish legal designation to protect habitat (e.g., Wilderness Area, Research Natural Area)		H	
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling			5.2 Policies & Regulations	Establish mitigation requirements for developments and other projects that impact species/habitats		M	
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)			5.3 Private Sector Standards & Codes	Implement Best Management Practices for agricultural production		M	
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown, population status unknown			8.0 Research & Monitoring	Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)		M	

Table B-2 - Continued.

Brimstone clubtail		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Medium	X	Unknown	X	Colorado Plateau	P	Colorado Plateau - Wyoming Basins Rivers	<input checked="" type="checkbox"/>
<i>Stylurus intricatus</i>		Taxonomic revision, species was placed into the genus <i>Stylurus</i> .							
Tier 2		Insects							
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
13.1 Complete distribution in Colorado unknown	Complete distribution in Colorado unknown	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H				
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Research population parameters and/or monitor status	H				
07.2 Dams & Water Management/Use	Natural system modification (hydrological) - dam construction, riprap, levees, bank stabilization, channelization, irrigation canals	2.3 Habitat & Natural Process Restoration		Adjust operation of dam	M				
07.2 Dams & Water Management/Use	Water use (de-watering of streams)	1.2 Resource & Habitat Protection		Acquire water rights or instream flow rights	M				
07.3 Other Ecosystem Modifications	Altered native vegetation (riparian area)	2.3 Habitat & Natural Process Restoration		Restore riparian vegetation	M				
09.2 Industrial & Military Effluents	Waste or residual materials (excess sediment loads)	5.3 Private Sector Standards & Codes		Implement Best Management Practices for agricultural production	M				
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development		Develop partnerships among agencies, NGOs, and stakeholders	M				
Red-veined meadowfly		Population Status and Trend		Distribution	Type	Habitat	Primary		
		Unknown	X	Unknown	X	Southern Rocky Mountains	P	Lakes	<input checked="" type="checkbox"/>
				Colorado Plateau		Wetlands			<input checked="" type="checkbox"/>
<i>Sympetrum madidum</i>				Utah High Plateau					
Tier 2		Insects		Wyoming Basin					
General Threat	Specific Threat	General Conservation Action		Specific Conservation Action	Priority				
01.1 Housing & Urban Areas	Urban, suburban, and ex-urban development	2.3 Habitat & Natural Process Restoration		Avoid destruction of large tracts of native habitat (e.g., ski area development, sod-busting)	H				
02.1 Annual & Perennial Non-Timber Crops	Conversion to cropland	5.2 Policies & Regulations		Encourage use of Farm Bill and other incentive programs	H				
07.2 Dams & Water Management/Use	Water use, management	5.3 Private Sector Standards & Codes		Implement Best Management Practices for water resource development	H				
12.2 Lack of funding	Lack of funding	7.2 Alliance & Partnership Development		Develop partnerships among agencies, NGOs, and stakeholders	H				
13.4 Population status unknown	Lack of data on population status	8.0 Research & Monitoring		Improve understanding of species/habitat distribution (field inventory, modeling, ground-truthing)	H				
07.3 Other Ecosystem Modifications	Natural system modification - wetland filling	5.3 Private Sector Standards & Codes		Implement Best Management Practices for urban development, landscaping, etc.	M				

Monitoring

Table B-3. Existing monitoring plans for insect SGCN.

Focus: SS = Single Species; MS = Multi-species. Agency/Organizations: BCNA = Boulder County Nature Association; CNHP = Colorado Natural Heritage Program; CPW = Colorado Parks & Wildlife; CSU = Colorado State University; USFS = U.S. Forest Service; USFWS = U.S. Fish & Wildlife Service.

Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
BUMBLEBEES						
<i>Bombus fervidus</i>	Yellow bumblebee	www.BumbleBeeWatch.org http://www.ars.usda.gov/SP2UserFiles/Place/20800500/2015MonitoringBumbleBeesInThePacificNorthwest.pdf	MS	X	National	Xerces Society
<i>Bombus fraternus</i>	Southern plains bumblebee	www.BumbleBeeWatch.org http://www.ars.usda.gov/SP2UserFiles/Place/20800500/2015MonitoringBumbleBeesInThePacificNorthwest.pdf	MS	X	National	Xerces Society
<i>Bombus morrisoni</i>	Morrison bumblebee	www.BumbleBeeWatch.org http://www.ars.usda.gov/SP2UserFiles/Place/20800500/2015MonitoringBumbleBeesInThePacificNorthwest.pdf	MS	X	National	Xerces Society
<i>Bombus occidentalis</i>	Western bumblebee	www.BumbleBeeWatch.org http://www.ars.usda.gov/SP2UserFiles/Place/20800500/2015MonitoringBumbleBeesInThePacificNorthwest.pdf	MS	X	National	Xerces Society
<i>Bombus pensylvanicus</i>	American bumblebee	www.BumbleBeeWatch.org http://www.ars.usda.gov/SP2UserFiles/Place/20800500/2015MonitoringBumbleBeesInThePacificNorthwest.pdf	MS	X	National	Xerces Society
<i>Bombus suckleyi</i>	Suckley cuckoo bumblebee	www.BumbleBeeWatch.org http://www.ars.usda.gov/SP2UserFiles/Place/20800500/2015MonitoringBumbleBeesInThePacificNorthwest.pdf	MS	X	National	Xerces Society
BUTTERFLIES, SKIPPERS, & MOTHS						
<i>Callophrys mossii schryveri</i>	Moss's elfin	A Continuing Study of Butterfly Populations and Other Species in Boulder County Open Spaces, Colorado. Self-Published. December, 2014. Janet Chu.	MS		Local	BCNA
<i>Celastrina humulus</i>	Hops feeding azure	A Continuing Study of Butterfly Populations and Other Species in Boulder County Open Spaces, Colorado. Self-Published. December, 2014. Janet Chu.	MS		Local	BCNA

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Species	Common Name	Document Citation	Focus	Long-term	Geographic Scope	Agency or Organization leads
<i>Danaus plexippus</i>	Monarch butterfly	A Continuing Study of Butterfly Populations and Other Species in Boulder County Open Spaces, Colorado. Self-Published. December, 2014. Janet Chu.	MS		Local	BCNA
<i>Euphilotes rita coloradensis</i>	Colorado blue	A Continuing Study of Butterfly Populations and Other Species in Boulder County Open Spaces, Colorado. Self-Published. December, 2014. Janet Chu.	MS		Local	BCNA
<i>Hesperia leonardus montana</i>	Pawnee montane skipper	(1) Pawnee Montane Skipper Monitoring Study for the Upper South Platte Watershed Protection and Restoration Project August 2013. Sovell, J. R., CO Natural Heritage Program. (2) Pawnee Montane Skipper Post-fire Habitat Assessment August/September 2012. Sovell, J. R., CO Natural Heritage Program.	SS		Range in CO	CNHP, USFS, USFWS
<i>Hesperia ottoe</i>	Ottoe skipper	A Continuing Study of Butterfly Populations and Other Species in Boulder County Open Spaces, Colorado. Self-Published. December, 2014. Janet Chu.	MS		Local	BCNA
STONEFLIES						
<i>Capnia arapahoe</i>	Arapahoe snowfly	Estimating the population size and distribution of the ARAPAHOE SNOWFLY (<i>Arsapnia arapahoe</i>) (Plecoptera: Capniidae) along the northern Front Range of Colorado. Belcher, T. 2015. Masters Thesis, Colorado State University, Fort Collins, Colorado.	SS		Local	CSU

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Hatfield, R., Jepsen, S., Thorp, R., Richardson, L. & Colla, S. 2014. *Bombus morrisoni*. The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org

Appendix C: Crosswalk of SWAP Habitats to SWReGAP Vegetation Mapping

Habitat	SWReGAP Code	SWReGAP Ecological System
FOREST AND WOODLAND HABITATS		
Aspen	S023	Rocky Mountain Aspen Forest and Woodland
Lodgepole	S031	Rocky Mountain Lodgepole Pine Forest
Mixed Conifer	S032	Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland
Mixed Conifer	S034	Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
Mixed Conifer	S042	Intermountain Basins Aspen Mixed Conifer Forest and Woodland
Pinyon-Juniper	S038	Southern Rocky Mountain Pinyon-Juniper Woodland
Pinyon-Juniper	S039	Colorado Plateau Pinyon Juniper Woodland
Pinyon-Juniper	S052	Colorado Plateau Pinyon-Juniper Shrubland
Pinyon-Juniper	S074	Southern Rocky Mountain Juniper Woodland and Savanna
Pinyon-Juniper	S075	Intermountain Basins Juniper Savanna
Pinyon-Juniper	S125	Rocky Mountain Foothill Limber Pine-Juniper Woodland
Ponderosa Pine	S036	Rocky Mountain Ponderosa Pine Woodland
Spruce-Fir	S028	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
Spruce-Fir	S030	Rocky Mountain Subalpine Mesic Spruce Fir Forest and Woodland
Subalpine Limber/Bristlecone	S025	Rocky Mountain Subalpine Montaine Limber Bristlecone Pine Woodland
SHRUBLAND HABITATS		
Desert Shrub	S014	Intermountain Basins Wash
Desert Shrub	S059	Colorado Plateau Blackbrush-Mormon-tea Shrubland
Desert Shrub	S065	Intermountain Basins Mixed Salt Desert Shrub
Desert Shrub	S079	Intermountain Basins Semi-desert Shrub Steppe
Desert Shrub	S090	Intermountain Basins Semi-Desert Grassland
Greasewood	S096	Intermountain Basins Greasewood Flat
Oak & Mixed Mountain Shrub	S046	Rocky Mountain Gambel Oak-Mixed Montane Shrubland
Sagebrush	S054	Intermountain Basin Big Sagebrush Shrubland
Sagebrush	S056	Colorado Plateau Mixed Low Sagebrush Shrubland
Sagebrush	S071	Intermountain Basins Montane Sagebrush Steppe
Sagebrush	S128	Wyoming Basins Low Sagebrush Shrubland
Saltbush	S011	Intermountain Basins Shale Badland
Saltbush	S045	Intermountain Basins Mat Saltbrush Shrubland

Colorado's 2015 State Wildlife Action Plan

Habitat	SWReGAP Code	SWReGAP Ecological System
Sandsage	S048	Western Great Plains Sandhill Shrubland
Sandsage	S089	Western Great Plains Sandhill Prairie
Upland Shrub	S047	Rocky Mountain Lower Montane Foothill Shrubland
Upland Shrub	S050	Intermountain Basins Mountain Mahogany Woodland and Shrubland
GRASSLAND HABITATS		
Foothill & Mountain Grasslands	S085	Southern Rocky Mountain Montane Subalpine Grassland
Foothill & Mountain Grasslands	S086	Western Great Plains Foothill and Piedmont Grassland
Mixed & Tallgrass Prairies	S087	Central Mixedgrass Prairie
Mixed & Tallgrass Prairies	S132	Western Great Plains Tallgrass Prairie
Shortgrass Prairie	S088	Western Great Plains Shortgrass Prairie
RIPARIAN AND WETLAND HABITATS		
Playas ²⁶	S015	Intermountain Basins Playa
Riparian Woodlands & Shrublands	S091	Rocky Mountain Subalpine Montane Riparian Shrubland
Riparian Woodlands & Shrublands	S092	Rocky Mountain Subalpine Montane Riparian Woodland
Riparian Woodlands & Shrublands	S093	Rocky Mountain Lower Montane Riparian Woodland and Shrubland
Riparian Woodlands & Shrublands	S095	Western Great Plains Riparian Woodland and Shrubland
Wetlands	S083	Rocky Mountain Subalpine Mesic Meadow
Wetlands	S091	Rocky Mountain Subalpine Montane Riparian Shrubland
Wetlands	S100	North American Arid West Emergent Marsh
Wetlands	S102	Rocky Mountain Alpine-Montane Wet Meadow
Wetlands	S120	Western Great Plains Floodplain Herbaceous Wetland
AQUATIC HABITATS		
Colorado Plateau-Wyoming Basins Rivers		no ReGAP equivalent
Colorado Plateau-Wyoming Basins Rivers Streams		no ReGAP equivalent
Eastern Plains Rivers		no ReGAP equivalent
Eastern Plains Streams		no ReGAP equivalent
Lakes		no ReGAP equivalent
Mountain Streams		no ReGAP equivalent
Rio Grande Valley Rivers		no ReGAP equivalent
Rio Grande Valley Streams		no ReGAP equivalent

²⁶Playas on Colorado's eastern plains were not mapped as a distinct ecological system in SWReGAP, so data from Rocky Mountain Bird Observatory and Playa Lakes Joint Venture were used to represent these features on SWAP maps.

Colorado's 2015 State Wildlife Action Plan

Habitat	SWReGAP Code	SWReGAP Ecological System
Transition Zone Streams		no ReGAP equivalent
OTHER HABITATS		
Agriculture	N80	Agriculture
Alpine	S001	North American Alpine Ice Field
Alpine	S002	Rocky Mountain Alpine Bedrock and Scree
Alpine	S004	Rocky Mountain Alpine Fell-Field
Alpine	S081	Rocky Mountain Dry Tundra
Cliffs & Canyons	S006	Rocky Mountain Cliff Canyon and Massive Bedrock
Cliffs & Canyons	S008	Western Great Plains Cliff and Outcrop
Cliffs & Canyons	S009	Intermountain Basins Cliff and Canyon
Cliffs & Canyons	S010	Colorado Plateau Mixed Bedrock Canyon and Tableland
Conservation Reserve Program		No ReGAP equivalent
Hot Springs		no ReGAP equivalent
Reservoirs & Shorelines		no ReGAP equivalent
Sand Dunes	S012	Intermountain Basins Active and Stabilized Dune

Appendix D: Species Conservation Plans

AMPHIBIANS

Boreal Toad

Boreal Toad (*Bufo boreas boreas*): a technical conservation assessment (2005)

<http://www.fs.fed.us/r2/projects/scp/assessments/borealtoad.pdf>

Conservation Plan and Agreement for the management and recovery of the Southern Rocky Mountain population of the Boreal Toad (*Bufo boreas boreas*) (2001)

<http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/BorealToad/BorealToadRecovery.pdf>

Northern Leopard Frog

Northern Leopard Frog (*Rana pipiens*): a technical conservation assessment (2007)

<http://www.fs.fed.us/r2/projects/scp/assessments/northernleopardfrog.pdf>

BIRDS

Burrowing Owl

Western Grasslands Initiative – a Plan for Conserving Grassland Habitat and Wildlife (2011)

<http://www.wafwa.org/documents/WGISTRATPLAN.pdf>

Burrowing Owl (*Athene cunicularia*): a technical conservation assessment (2004)

<http://www.fs.fed.us/r2/projects/scp/assessments/burrowingowl.pdf>

Conservation Plan for Grassland Species in Colorado (2003)

<http://cpw.state.co.us/Documents/WildlifeSpecies/Grasslands/wholeplan.pdf>

Status Assessment and Conservation Plan for Western Burrowing Owl in the U.S. (2003)

<https://www.fws.gov/mountain-prairie/species/birds/wbo/Western%20Burrowing%20Owlrev73003a.pdf>

Columbian Sharp-tailed Grouse

Columbian Sharp-tailed Grouse (*Tympanuchus phasianellus columbianus*): a technical conservation assessment (2007)

<http://www.fs.fed.us/r2/projects/scp/assessments/columbiansharptailedgrouse.pdf>

Columbian Sharp-tailed Grouse Conservation Plan, Routt, Moffat, and Rio Blanco Counties, Northwest Colorado (2001)

http://cpw.state.co.us/Documents/WildlifeSpecies/ColumbianSharptailedGrouseConsPlan2001_NWCO.pdf

Guidelines for the Management of Columbian Sharp-Tailed Grouse Populations and Their Habitats.

Greater Sage-grouse

Greater Sage-Grouse: Colorado Statewide Conservation Plan (2008); the Colorado Synthesis Report (2014) and the Colorado Package (2013)

<http://cpw.state.co.us/learn/Pages/GreaterSagegrouseConservationPlan2.aspx>

Greater Sage-grouse Conservation Plan – Parachute-Piceance-Roan (2008)

<http://cpw.state.co.us/learn/Pages/SagegrouseLocalGroupPlans.aspx>

Northwest Colorado Greater Sage-grouse Conservation Plan (2008)

<http://cpw.state.co.us/learn/Pages/SagegrouseLocalGroupPlans.aspx>

Greater Sage-grouse Comprehensive Conservation Strategy (2006)

<http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GreaterSageGrouse/GreaterSage-grouseNationalConservationStrategy.pdf>

Greater Sage-grouse Conservation Plan, Northern Eagle and Southern Routt Counties (2004)

http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GreaterSageGrouse/Eagle_SoRoutt.pdf

North Park (2001) and Middle Park (2004) Greater Sage-grouse Conservation Plans

<http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GreaterSageGrouse/NorthPark.pdf>

<http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GreaterSageGrouse/MiddlePark.pdf>

Greater Sandhill Crane

Recovery Plan for the Colorado Population of the Greater Sandhill Crane (1992)

Gunnison Sage Grouse

Federal listing documents:

<http://www.gpo.gov/fdsys/pkg/FR-2014-11-20/pdf/2014-27109.pdf>

[http://www.fws.gov/mountain-](http://www.fws.gov/mountain-prairie/es/species/birds/gunnisonsagegrouse/GUSGFinalListingRule_11202014.pdf)

[prairie/es/species/birds/gunnisonsagegrouse/GUSGFinalListingRule_11202014.pdf](http://www.fws.gov/mountain-prairie/es/species/birds/gunnisonsagegrouse/GUSGFinalListingRule_11202014.pdf)

Crawford Area Gunnison Sage-grouse Conservation Plan (2011)

http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GunnisonSageGrouse/GunnisonSageGrouseLocalPlan_Crawford.pdf

Gunnison Sage Grouse Conservation Plan, San Miguel Basin, Colorado (2009)

<http://cpw.state.co.us/learn/Pages/SagegrouseLocalGroupPlans.aspx>

Candidate Conservation Agreement with Assurances for Gunnison Sage-grouse (*Centrocercus minimus*) between Colorado Parks & Wildlife and the U.S. Fish & Wildlife Service (2006)

<http://cpw.state.co.us/learn/Pages/CCAA.aspx>

Gunnison Sage-grouse Rangewide Conservation Plan (2005)

<http://cpw.state.co.us/learn/Pages/GunnisonSagegrouseConservationPlan.aspx>

Gunnison Sage Grouse Conservation Plan, Piñon Mesa, Colorado (2000)

http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GunnisonSageGrouse/GunnisonSageGrouseLocalPlan_PinyonMesa.pdf

Poncha Pass Gunnison Sage Grouse Conservation Plan (2000)

http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GunnisonSageGrouse/GunnisonSageGrouseLocalPlan_PonchaPass.pdf

Gunnison Sage Grouse Conservation Plan, Dove Creek, Colorado (1998)

http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GunnisonSageGrouse/GunnisonSageGrouseLocalPlan_DoveCreek.pdf

Gunnison Sage Grouse Conservation Plan, San Miguel Basin, Colorado (1998)

http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GunnisonSageGrouse/GunnisonSageGrouseLocalPlan_SanMiguelBasin.pdf

Gunnison Sage Grouse Conservation Plan, Gunnison Basin, Colorado (1997)

http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/GunnisonSageGrouse/GunnisonSageGrouseLocalPlan_GunnisonBasin.pdf

Lesser Prairie-chicken

The Lesser Prairie-chicken Range-wide Conservation Plan (2013)

<http://www.wafwa.org/documents/2013LPCRWPfinalfor4drule12092013.pdf>

Lesser Prairie-chicken Conservation Initiative (2008)

http://www.wafwa.org/documents/LPCCI_FINAL.pdf

Lesser Prairie-chicken (*Tympanuchus pallicinctus*): a technical conservation assessment (2005)

<http://www.fs.fed.us/r2/projects/scp/assessments/lesserprairiechicken.pdf>

Federal listing documents: <http://www.fws.gov/southwest/es/LPC.html>

Mountain Plover

Western Grasslands Initiative – a Plan for Conserving Grassland Habitat and Wildlife (2011)

<http://www.wafwa.org/documents/WGISTRATPLAN.pdf>

Conservation Plan for Grassland Species in Colorado (2003)

<http://cpw.state.co.us/Documents/WildlifeSpecies/Grasslands/wholeplan.pdf>

Mountain Plover (*Charadrius montanus*): a technical conservation assessment (2003)

<http://www.fs.fed.us/r2/projects/scp/assessments/mountainplover.pdf>

Proposed federal listing documents:

<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B078>

Plains Sharp-tailed Grouse

Plains Sharp-tailed Grouse Recovery Plan (1992)

http://www.lm.doe.gov/cercla/documents/rockyflats_docs/IA/Revised%20IA-A-002965.pdf

Southern White-tailed Ptarmigan

Federal listing documents:

<http://www.gpo.gov/fdsys/pkg/FR-2012-06-05/pdf/2012-13320.pdf>

White-tailed Ptarmigan (*Lagopus leucura*): a technical conservation assessment (2006)

<http://www.fs.fed.us/r2/projects/scp/assessments/whitetailedptarmigan.pdf>

Southwestern Willow Flycatcher

Final Recovery Plan Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (2002)

Federal listing documents:

<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=B094>

Western Yellow-billed Cuckoo

Yellow-billed Cuckoo (*Coccyzus americanus*): a technical conservation assessment (2005)

<http://www.fs.fed.us/r2/projects/scp/assessments/yellowbilledcuckoo.pdf>

Federal listing documents:

<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=B06R>

FISH

Arkansas Darter

Arkansas Darter (*Etheostoma cragini*) Recovery Plan (2001)

Bluehead Sucker

State of Colorado conservation and management plan for the Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (in development)

Range-wide conservation agreement and strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (2006)
<http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/ChubSuckerRangewideConservationAgreementandStrategy01-04-07.pdf>

Bluehead Sucker (*Catostomus discobolus*): a technical conservation assessment (2005)

<http://www.fs.fed.us/r2/projects/scp/assessments/blueheadsucker.pdf>

Bonytail Chub

Bonytail (*Gila elegans*) Recovery Goals – Amendment and Supplement to the Bonytail Chub Recovery Plan (2002)

Brassy Minnow

South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development)

Colorado River Cutthroat Trout

Range-wide Status of Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*): 2010 (2013)

<https://cpw.state.co.us/Documents/Research/Aquatic/CutthroatTrout/CRCTRangewideAssessment-08.04.2013.pdf>

Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*): a technical conservation assessment (2008)

<http://www.fs.fed.us/r2/projects/scp/assessments/coloradorivercutthroattrout.pdf>

Conservation Agreement for Colorado River Cutthroat Trout (*Oncorhynchus clarkii pleuriticus*) in the States of Colorado, Utah, and Wyoming (2006) http://www.fws.gov/mountain-prairie/species/fish/crct/CRCT_Conservation_Agreement_Final_Dec06.pdf

Colorado Pikeminnow

Colorado Pikeminnow (*Ptychocheilus lucius*) Recovery Goals – Amendment and Supplement to the Colorado Squawfish Recovery Plan (2002)

<http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/recoverygoals/Coloradopikeminnow.pdf>

Colorado Squawfish Revised Recovery Plan (1991)

<http://babel.hathitrust.org/cgi/pt?id=mdp.39015024895156;view=1up;seq=5>

Common Shiner

South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development)

Flannelmouth Sucker

State of Colorado conservation and management plan for the Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (in development)

Range-wide conservation agreement and strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (2006)

<http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/ChubSuckerRangewideConservationAgreementandStrategy01-04-07.pdf>

Flannelmouth Sucker (*Catostomus latipinnis*): a technical conservation assessment (2005)

<http://www.fs.fed.us/r2/projects/scp/assessments/flannelmouthsucker.pdf>

Greenback Cutthroat Trout

Greenback Cutthroat Trout (*Oncorhynchus clarkii stomias*): a technical conservation assessment (2009) <http://www.fs.fed.us/r2/projects/scp/assessments/greenbackcutthroattrout.pdf>

Greenback Cutthroat Trout Recovery Plan (1998)
http://ecos.fws.gov/docs/recovery_plans/1998/980301.pdf

Humpback Chub

Humpback Chub (*Gila cypha*) Recovery Goals – Amendment and Supplement to the Humpback Chub Recovery Plan (2002) http://www.fws.gov/doi/suppl/10.3996/082012-JFWM-071/suppl_file/10.3996_082012-jfwm-071.s12.pdf

Humpback Chub 2nd Revised Recovery Plan (1990)
http://www.fws.gov/southwest/es/arizona/Documents/RecoveryPlans/Humpback_Chub_1990.pdf

Northern Redbelly Dace

South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development)

Northern Redbelly Dace (*Phoxinus eos*): a technical conservation assessment (2006)
<http://www.fs.fed.us/r2/projects/scp/assessments/northernredbellydace.pdf>

Plains Minnow

South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development)

Plains Minnow (*Hybognathus placitus*): a technical conservation assessment (2005)
<http://www.fs.fed.us/r2/projects/scp/assessments/plainsminnow.pdf>

Razorback Sucker

Razorback Sucker (*Xyrauchen texanus*) Recovery Goals – Amendment and Supplement to the Razorback Sucker Recovery Plan (2002) <http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/recoverygoals/Razorbacksucker.pdf>

Razorback Sucker (*Xyrauchen texanus*) Recovery Plan (1998)
http://www.fws.gov/southwest/es/arizona/Documents/RecoveryPlans/Razorback_Sucker_98.pdf

Rio Grande Chub

Rio Grande Chub (*Gila pandora*): a technical conservation assessment (2005)
<http://www.fs.fed.us/r2/projects/scp/assessments/riograndechub.pdf>

Rio Grande Cutthroat Trout

Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*) Conservation Strategy (2013)
http://www.fws.gov/southwest/es/newmexico/documents/RGCT_conservation_strategy_final_12-10-13.pdf

Conservation Agreement for Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*) in the States of Colorado and New Mexico (2009)
<https://cpw.state.co.us/Documents/Research/Aquatic/pdf/ConservationAgreementRioGrandeCutthroatTrout.pdf>

Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*): a technical conservation assessment (2006)
<http://www.fs.fed.us/r2/projects/scp/assessments/riograndecutthroattrout.pdf>

Conservation plan for Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*) in Colorado.

Rio Grande Sucker

Rio Grande Sucker (*Catostomus plebeius*): a technical conservation assessment (2005)
<http://www.fs.fed.us/r2/projects/scp/assessments/riograndesucker.pdf>

State of Colorado Rio Grande Sucker Recovery Plan (1994)

Roundtail Chub

State of Colorado conservation and management plan for the Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (in development)

Range-wide conservation agreement and strategy for Roundtail Chub (*Gila robusta*), Bluehead Sucker (*Catostomus discobolus*), and Flannelmouth Sucker (*Catostomus latipinnis*) (2006)
<http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/ChubSuckerRangewideConservationAgreementandStrategy01-04-07.pdf>

Roundtail Chub (*Gila robusta robusta*): a technical conservation assessment (2005)
<http://www.fs.fed.us/r2/projects/scp/assessments/roundtailchub.pdf>

Southern Redbelly Dace

South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development)

Southern Redbelly Dace (*Phoxinus erythrogaster*): a Technical Conservation Assessment (2007)
<http://www.fs.fed.us/r2/projects/scp/assessments/southernredbellydace.pdf>

Suckermouth Minnow

South Platte Native Fish Conservation Plan & Arkansas Native Fish Conservation Plan (in development)

MAMMALS

Black-footed Ferret

Black-footed Reintroduction Program <http://blackfootedferret.org>

A Cooperative Plan for Black-footed Ferret Reintroduction and Management, Wolf Creek and Coyote Basin Management Areas, Moffat and Rio Blanco Counties (2001)

http://www.blm.gov/pgdata/etc/medialib/blm/co/programs/oil_and_gas/Lease_Sale.Par.11136.File.dat/Wolf_Creek_Black-footed_Ferret_Management_Plan.pdf

Black-footed Ferret Recovery Plan (1988)

http://ecos.fws.gov/docs/recovery_plans/1988/880808.pdf

Black-tailed Prairie Dog

Western Grasslands Initiative – a Plan for Conserving Grassland Habitat and Wildlife (2011)

<http://www.wafwa.org/documents/WGISTRATPLAN.pdf>

Conservation Plan for Grassland Species in Colorado (2003)

<http://cpw.state.co.us/Documents/WildlifeSpecies/Grasslands/wholeplan.pdf>

A Multi-State Conservation Plan for the Black-tailed Prairie Dog, *Cynomys ludovicianus*, in the United States, Addendum to the black-tailed prairie dog conservation assessment and strategy, 1999 (2003)

http://www.azgfd.gov/w_c/nongameandendangeredwildlifeprogram/documents/080623_BT_PD_Multi-StateConservationPlan_Final.pdf

Fringed Myotis

Colorado Bat Conservation Plan (2004)

<http://www.cnhp.colostate.edu/teams/zoology/cbwg/pdfs/ColoradoBatConservationPlanFebruary2004.pdf>

Fringed Myotis (*Myotis thysanodes*): a technical conservation assessment (2004)

<http://www.fs.fed.us/r2/projects/scp/assessments/fringedmyotis.pdf>

Gunnison's Prairie Dog

Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy (2010)

http://cpw.state.co.us/Documents/WildlifeSpecies/Mammals/PrairieDogConservationPlan/ColoradoGunnisonsandWhite-tailedPrairieDogConservationStrategy_070910.pdf

Gunnison's Prairie Dog Conservation Assessment (2005)

http://cpw.state.co.us/Documents/WildlifeSpecies/Profiles/GPD_Assessment2005.pdf

Little Brown Myotis

Colorado Bat Conservation Plan (2004)

<http://www.cnhp.colostate.edu/teams/zoology/cbwg/pdfs/ColoradoBatConservationPlanFebruary2004.pdf>

Lynx

Protocol for Monitoring Canada Lynx in Colorado (2014)

Federal listing documents:

<http://ecos.fws.gov/speciesProfile/profile/displayAllDocuments!fedreg.action?sPCODE=A073>

Recovery outline: [http://www.fws.gov/mountain-](http://www.fws.gov/mountain-prairie/species/mammals/lynx/final%20lynx%20recoveryoutline9-05.pdf)

[prairie/species/mammals/lynx/final%20lynx%20recoveryoutline9-05.pdf](http://www.fws.gov/mountain-prairie/species/mammals/lynx/final%20lynx%20recoveryoutline9-05.pdf)

New Mexico Meadow Jumping Mouse

Federal listing documents:

<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=A0BX>

Preble's Meadow Jumping Mouse

Federal listing documents:

<http://www.fws.gov/mountain-prairie/species/mammals/preble/>

Draft Recovery Plan Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) (2003)

[http://www.fws.gov/mountain-](http://www.fws.gov/mountain-prairie/species/mammals/preble/RECOVERY%20PLAN/Nov2003DraftRecoveryPlan.pdf)

[prairie/species/mammals/preble/RECOVERY%20PLAN/Nov2003DraftRecoveryPlan.pdf](http://www.fws.gov/mountain-prairie/species/mammals/preble/RECOVERY%20PLAN/Nov2003DraftRecoveryPlan.pdf)

Spotted Bat

Spotted Bat (*Euderma maculatum*): a technical conservation assessment (2007)

<http://www.fs.fed.us/r2/projects/scp/assessments/spottedbat.pdf>

Colorado Bat Conservation Plan (2004)

<http://www.cnhp.colostate.edu/teams/zoology/cbwg/pdfs/ColoradoBatConservationPlanFebruary2004.pdf>

Townsend's Big-eared Bat

Townsend's Big-eared Bat (*Corynorhinus townsendii*): a technical conservation assessment

(2006) <http://www.fs.fed.us/r2/projects/scp/assessments/townsendbig-earedbat.pdf>

Colorado Bat Conservation Plan (2004)

<http://www.cnhp.colostate.edu/teams/zoology/cbwg/pdfs/ColoradoBatConservationPlanFebruary2004.pdf>

White-tailed Prairie Dog

Colorado Gunnison's and White-tailed Prairie Dog Conservation Strategy (2010)

http://cpw.state.co.us/Documents/WildlifeSpecies/Mammals/PrairieDogConservationPlan/ColoradoGunnisonsandWhite-tailedPrairieDogConservationStrategy_070910.pdf

White-tailed Prairie Dog (*Cynomys leucurus*): a technical conservation assessment (2006)

<http://www.fs.fed.us/r2/projects/scp/assessments/whitetailedprairiedog.pdf>

Wolverine

Federal listing documents:

<http://www.gpo.gov/fdsys/pkg/FR-2014-08-13/pdf/2014-18743.pdf>

<http://ecos.fws.gov/speciesProfile/profile/displayAllDocuments!fedreg.action;jsessionid=04824756A942C6F511FBFB5DE468B7B3?scode=A0FA>

REPTILES

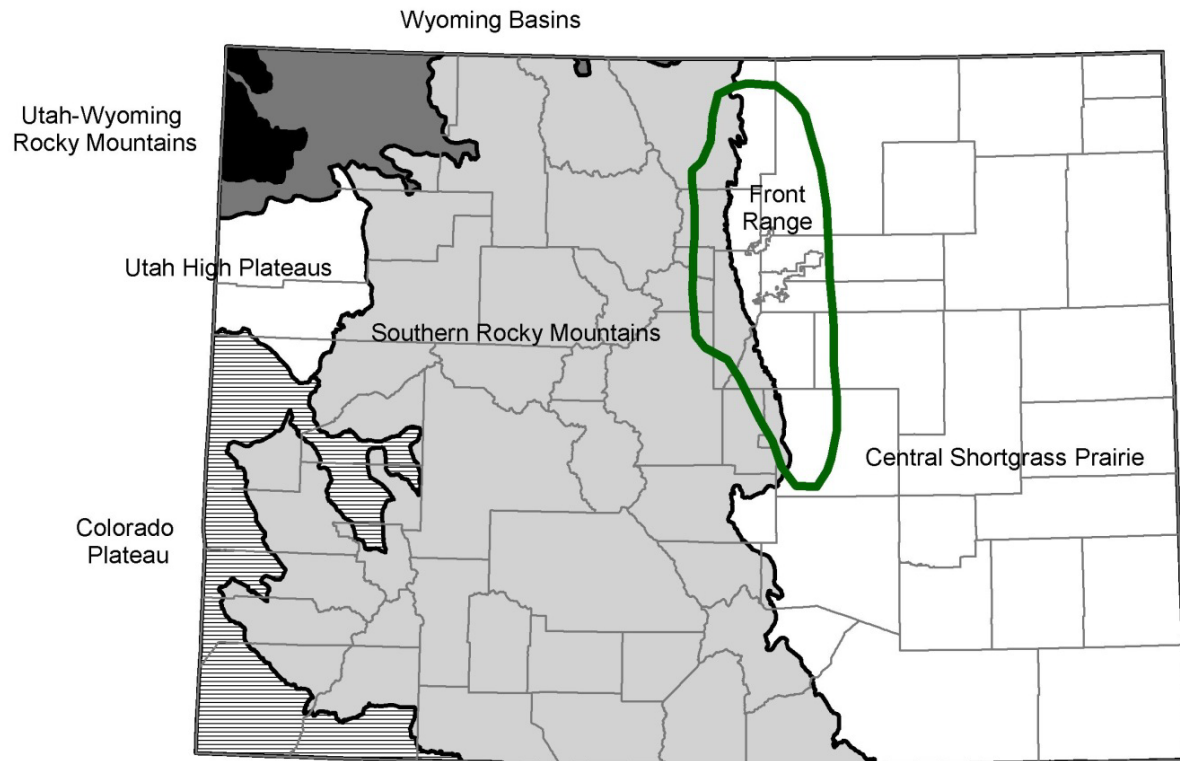
Massasauga

Desert Massasauga Rattlesnake (*Sistrurus catenatus edwardsii*): a technical conservation assessment (2005) <http://www.fs.fed.us/r2/projects/scp/assessments/massasauga.pdf>

Colorado Checkered Whiptail

Federal listing documents: <http://www.gpo.gov/fdsys/pkg/FR-2015-07-01/pdf/2015-16001.pdf>

Appendix E: Key to Species and Habitat Distributions



Appendix F: Climate Change Assessment

The description of the climate change vulnerability assessment that follows has been simplified for inclusion in the SWAP. Readers who are interested in more detailed technical methods can access the full vulnerability assessment report (Decker and Fink 2014) at

http://www.cnhp.colostate.edu/download/documents/2014/CO_SWAP_Enhancement_CCVA.pdf

Colorado Parks and Wildlife provided funding for this effort. The U.S. Geological Service and the North Central Climate Science Center contributed essential technical tools and facilitated collaboration with climate scientists, which greatly assisted the data selection, analysis methods, and interpretation. The Colorado Natural Heritage Program contributed ecological expertise, performed the analyses, and wrote this report.

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Introduction

In recognition of the growing threat posed by climate change, the Association of Fish and Wildlife Agencies (AFWA) has recommended that states incorporate the impacts of climate change into the ten-year SWAP revisions required to be completed by 2015, and provided guidance for this task (AFWA 2009, 2012). Following this guidance, and with funding from the U.S. Fish and Wildlife Service's State Wildlife Grants program, Colorado Parks and Wildlife (CPW) collaborated with the Colorado Natural Heritage Program (CNHP), the U.S. Geological Service (USGS), and the North Central Climate Science Center (NCCSC) to evaluate the relative vulnerability of 13 habitats to climate change (Table 1).

Objectives of the analysis were to:

1. Identify the degree of climate change expected between current and future conditions for climate factors believed to influence the distribution of the habitat.
2. Assess factors that affect the resilience of the habitat to change in landscape condition, including invasive or problematic native species presence, dynamic process alteration between past and current conditions, and the characteristic bioclimatic envelope (i.e., tolerance for specific climate factors such as temperature and moisture) of the habitat.
3. Produce summary vulnerability ratings for priority habitats.

This vulnerability assessment is intended to be part of a dynamic, iterative, multi-scale process that will focus management actions on strategies that are effective under both current and future climates. This analysis is based on a relatively short temporal scale (i.e., suited to agency planning horizons and attentive to uncertainty levels in projected climate models), and the use of a limited but representative set of potential climate change scenarios.

Methods

Characterizing Vulnerability

The AFWA best practices recommend the Glick et al. (2011) method for assessing vulnerability to climate change. The primary components of this method are projected *exposure* to climate change, *sensitivity* of the species or ecosystem to expected changes, and the *adaptive capacity* of the species or ecosystem to respond to changes (Figure 1). Although this diagram is straightforward and conceptually simple, the individual components of exposure, sensitivity, and adaptive capacity can be difficult to calculate with any precision. Uncertainty comes from both

the degree of variation in the many climate projection models, and from the gaps in our knowledge of the target species or habitat.

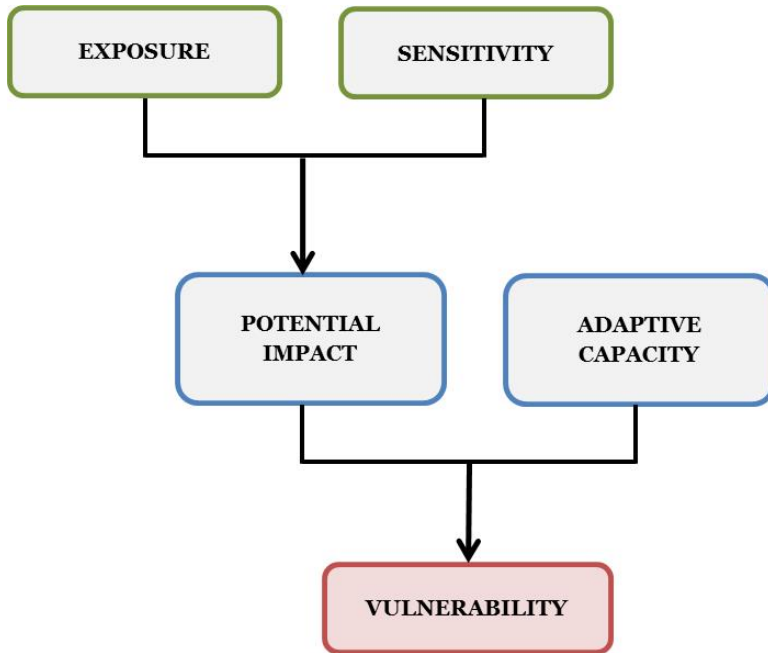


Figure F-1. Components of vulnerability (Glick et al. 2011).

Our analysis followed the generalized approach represented in Figure 1, but we also drew from other approaches to vulnerability assessments where appropriate, as described in the following sections. We evaluated exposure and sensitivity using GIS methods developed in collaboration with the NCCSC, and assigned a combined exposure-sensitivity rank. We then evaluated adaptive capacity using methods adapted from the Manomet Center for Conservation Science and Massachusetts Division of Fish and Wildlife (MCCS and MAFW 2010), and assigned an adaptive capacity rank. The Overall Vulnerability Rank was calculated from these two sub-ranks using a method derived from NatureServe’s Habitat Climate Change Vulnerability Index (Comer et al. 2012).

Habitats Assessed

In consultation with CPW, CNHP identified 13 habitat types that were high priorities for inclusion in the assessment, based on their importance to Species of Greatest Conservation Need previously identified in the 2005 SWAP. Some habitat types cross multiple elevational gradients, and function differently or contain different component species depending upon their elevation and/or their distribution within the state (western slope, mountains, eastern plains). For some components of the analysis, these habitats were broken out, as reflected in Table 1.

Table F-1. Habitats assessed for vulnerability to climate change.

Target Habitats	
Forests and Woodlands	Grasslands
Lodgepole pine forest	Foothill & mountain grassland (high elevation, low elevation)
Pinyon-Juniper woodland	Shortgrass prairie
Ponderosa pine forest	Riparian & Wetlands
Spruce-Fir forest	Playas
Shrublands	Riparian woodland & shrubland (western slope, mountains, eastern plains)
Oak & mixed mountain shrubland	Wetlands (western slope, mountains, eastern plains)
Sagebrush shrubland	Other
Sandsage shrubland	Alpine

Exposure and Sensitivity Assessment

The assessment of exposure and sensitivity was comprised of the following steps:

- identify important climate variables for each habitat,
- characterize projected future climate,
- calculate projected shift in range of climate variables,
- assign ranks (high, moderate, low) for the exposure/sensitivity component.

Climate Variables

We know that the distribution of key species comprising each habitat type (spruce, fir, sagebrush, and so on) is driven at least partially by environmental components such as temperature, moisture, and soil. There is much uncertainty about exactly how various components interact in each habitat, but assessing vulnerability to changes in climate requires that some determinations be made about which climate variables are most likely to be limiting factors. Thus, our goal for this portion of the analysis was to identify the climate variables that appear to be *most* influential in determining the distribution of each habitat. We used three sources of information for this: 1) habitat distribution modeling (for a subset of habitat types); 2) expert review from CPW habitat coordinators and CNHP ecologists; and 3) literature review.

For nine of the upland habitat types, we used models of current distribution for each habitat to identify important climate variables for that habitat. Modeling methods were developed with the

assistance of USGS Fort Collins Science Center and the North Central Climate Science Center, and are detailed in the technical report Decker and Fink 2014²⁷.

This method was followed for all habitats that occur at the landscape scale. For the four habitats that occur at smaller spatial scales (foothill and mountain grasslands, riparian, wetland, and playas), rather than generating distribution models to identify the most important climate variables, we relied on expert opinion from CPW and CNHP in conjunction with literature review.

For each habitat, the five climate variables that were judged to be the most significant for that habitat were reviewed by CPW staff and CNHP ecologists. Some adjustments to the analysis were made based on this expert review and information gleaned from published scientific literature. The final climate variables used to assess exposure and sensitivity for all habitats are presented in Table 2.

²⁷ http://www.cnhp.colostate.edu/download/documents/2014/CO_SWAP_Enhancement_CCVA.pdf

Table F-2. Climate variables used to assess each habitat (shaded cells); ppt = precipitation, GDD = growing degree days.

Habitat Target	Winter ppt	Spring ppt	Summer ppt	Fall ppt	Annual ppt	Heavy ppt days	Drought days	Date of last frost	Date of first frost	Winter min temp	Winter avg temp	Spring avg temp	Summer avg temp	Annual avg temp	GDD	Very hot days	Very cold days
Forests and Woodlands																	
Lodgepole pine forest	■	■	■								■						■
Pinyon-Juniper woodland	■	■	■										■				■
Ponderosa pine forest			■	■						■			■			■	
Spruce-Fir forest	■	■								■			■		■		
Shrublands																	
Oak & mixed mountain shrub		■	■				■	■						■			
Sagebrush shrubland	■	■	■						■							■	
Sandsage shrubland	■	■					■								■	■	
Grasslands																	
Foothill & mountain grassland	■				■		■				■		■				
Shortgrass prairie					■	■	■					■	■				
Riparian & Wetlands																	
Playas		■	■				■					■	■				
Riparian woodland/shrubland (West)			■	■								■	■			■	
Riparian woodland/shrubland (Mtns)	■	■				■				■	■						
Riparian woodland/shrubland (East)		■	■				■					■	■				
Other Habitats																	
Alpine	■	■				■							■		■		

Mid-century Climate Projections

In consultation with CPW, we selected mid-century as the time frame for this analysis. This period was judged to be suitable to agency planning horizons and attentive to uncertainty levels in projected climate models. Based on direction from CPW, we based the analysis on the second-highest scenario for future greenhouse gas emissions (referred to hereafter as RCP6; for readers familiar with emissions scenarios, the new RCP6 scenario is loosely equivalent to the former A2 emissions scenario).

To assess projected changes, we used 12 climate projection models averaged over 1980-2005 to represent "historic normal" (current) for temperature and precipitation, and compared this with models averaged over 2035-2060 to represent mid-century projections (2050; BCCA 2013). The different inputs and methods used by each modeling center result in a range of outcomes, reflecting the inherent uncertainty in projecting future climatic conditions. Precipitation projections in particular vary widely from model to model. To capture the range of uncertainty in the most useful way possible, we chose the central 80% of the 12-model range to represent the "reasonable range" of possible future climate for each variable (Figure 2). In evaluating habitat exposure to climate change, we generally concentrated on the "worst case" end of the range, representing either the warmest projected conditions for temperature variables or the driest projected conditions for precipitation variables. This gives managers the option to plan for the "worst case" change in climate.

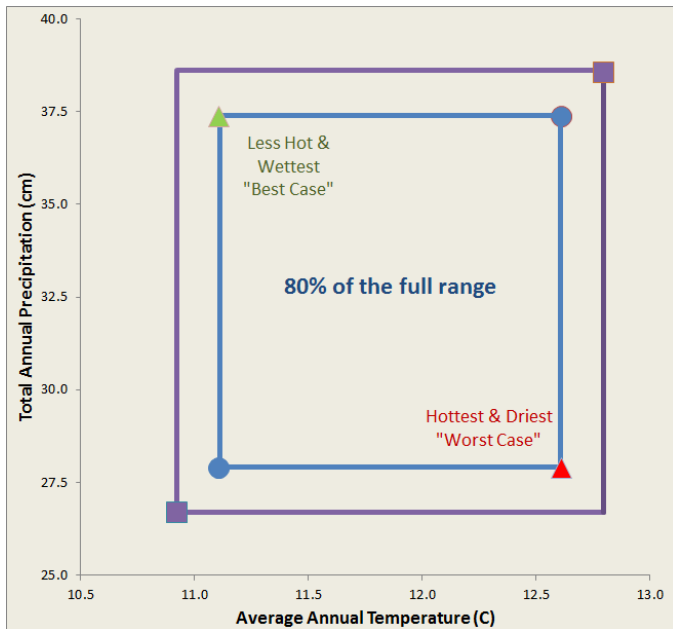


Figure F-2. Illustration of method for summarizing the 12 climate projection models.

Exposure to climate envelope shift

Exposure was evaluated by assessing the degree to which future climate conditions within the habitat's current distribution, as mapped in Southwest ReGAP, were projected to be outside the core range of current conditions, i.e., the "range shift" of the habitat's climate envelope (Figure 3). For each variable, the percent of current mapped acreage that is projected to fall below or above (depending on the direction of greatest stress in the "worst case" – e.g., either warmest or driest conditions) the current range was calculated. Although a number of models project increased precipitation for our area, we focused on potentially drier alternatives to account for the drying effects of increasing temperature. A negative value indicates improving conditions for that habitat, while a positive value indicates exposure conditions that are presumed to be more stressful.

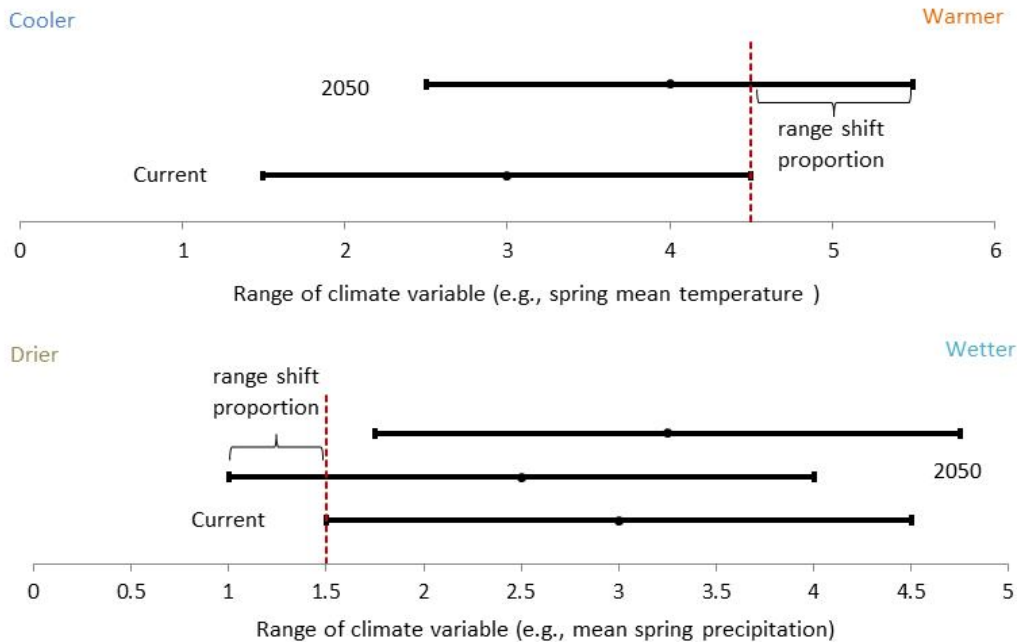


Figure 22. Generalized example of assessing the range shift for temperature or precipitation variables. The dashed line indicates the limit of the current range for that variable within a specific habitat.

Exposure-sensitivity Ranking

For each habitat, its projected exposure to climate change and its presumed sensitivity to that change are combined into a single rank. This rank incorporates the projected degree of change (exposure) for the five climate variables believed to be most important in determining the distribution of that habitat (sensitivity). Exposure-sensitivity ranks were assigned based on the average of the range shifts for the five climate variables for each habitat. Natural breaks in the results were used to determine the qualitative ranks of high, moderate, or low.

Confidence in Data

Uncertainty in this process comes from the probability that there are important climate variables that we either don't know about, or can't model. Additionally, critical variables controlling the distribution of a habitat may not be climate related (e.g., soils). Our intent was to use the best currently available information to make a best estimate of vulnerability with available information.

Resilience-Adaptive Capacity Assessment

The resilience-adaptive capacity component of the assessment considered indirect effects and non-climate stressors that may interact with climate change to influence how well or poorly the habitat can respond to changing conditions. Factors evaluated are adapted from the methods used by Manomet Center for Conservation Science and Massachusetts Division of Fish and Wildlife (MCCS and MAFW 2010), combined under the five headings presented in Table 3. For each factor, habitats were assigned a score based on a scale of 0 (increased vulnerability) to 1 (decreased vulnerability).

Table F-3. Description of factors used to assess resilience-adaptive capacity.

Assessment factor	Description
Bioclimatic envelope and range	Expected effects of limited elevational or bioclimatic ranges for a habitat. Suitable conditions for habitats at upper elevations may be eliminated. Habitats with narrow bioclimatic envelopes may be more vulnerable to climate change. Finally, habitats that are at the southern edge of their distribution in Colorado may be eliminated from the state under warming conditions.
Growth form and intrinsic dispersal rate	Overall ability of the habitat's component species to shift their ranges in response to climate change relatively quickly. Characteristics of growth form, seed-dispersal capability, vegetative growth rates, and stress-tolerance are considered.

Assessment factor	Description
Vulnerability to increased impact by biological stressors	Whether expected future biological stressors (invasive species, grazers and browsers, pests and pathogens) have had, or are likely to have, an increased effect due to interactions with changing climate. Climate change may result in more frequent or more severe outbreaks of these stressors. Habitats that are currently vulnerable to these stressors may become more so under climate change.
Vulnerability to increased frequency or intensity of extreme events	Characteristics of a habitat that make it relatively more vulnerable to extreme events (fire, drought, floods, windstorms, dust on snow, etc.) that are projected to become more frequent and/or intense under climate change.
Other indirect effects of non-climate stressors – landscape condition	Overall condition of the habitat at the landscape level across Colorado, and is derived from a landscape integrity score indexing the degree of anthropogenic disturbance (Rondeau et al. 2011, Lemly et al. 2011).

Bioclimatic envelope and range

Each habitat was scored for elevation, southern edge of range, annual precipitation range, and growing degree days range. Habitats restricted to high elevations received a score of 0, other habitats scored 1. Likewise, habitats at the southern edge of their continental range in Colorado were assigned a score of 0, and other habitats scored 1. Annual precipitation and growing degree days range were calculated as the proportion of total variable range in Colorado in which the habitat had significant presence mapped. These four sub-scores were averaged to produce a single score for this factor.

Growth form and intrinsic dispersal rate

Scores of 0 (low resilience), 0.5 (uncertain or moderate resilience), and 1 (high resilience) were assigned to each habitat based on growth form of the dominant species (i.e., trees scored 0, shrubs and herbaceous species scored 1), and other information derived from the literature regarding the dispersal abilities of those species.

Vulnerability to increased attack by biological stressors

For each biological stressor (insects, disease, etc.) to which a habitat is believed vulnerable, 0.33 was subtracted from a default score of 1, to produce the final habitat score.

Vulnerability to increased frequency or intensity of extreme events

For each non-biological stressor (fires, floods, etc.) to which a habitat is believed vulnerable, 0.33 was subtracted from a default score of 1, to produce the final habitat score.

Landscape condition

The average value across existing landscape integrity models developed by CNHP (Rondeau et al. 2011, Lemly et al. 2011) for each habitat was calculated as a value between 0 and 1. Landscape

integrity models describe the degree of human alteration in a landscape, based on the presence of mappable infrastructure (urban developments, roads, mines, oil wells, and so on).

Resilience-Adaptive Capacity Ranking

The final Resilience-Adaptive Capacity rank is a rounded average of the scores for the five factors listed in Table 3. Note that ranking scheme for Resilience-Adaptive Capacity is opposite the Exposure-Sensitivity ranking scheme (i.e., a positive value indicates “better” and a negative value indicates “worse”).

Overall Vulnerability Assessment Ranking

The Overall Vulnerability Rank was determined by combining the Exposure-Sensitivity rank and the Resilience-Adaptive Capacity rank according to the scheme presented in Figure 4 (following NatureServe’s HCCVI methods described in Comer et al. 2012).

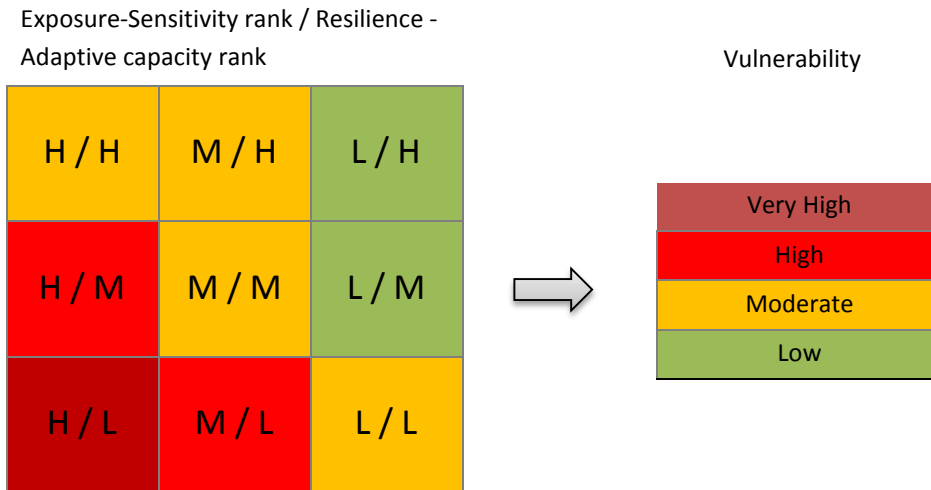


Figure F-4. Vulnerability ranking matrix.

Very High: Habitats have very high vulnerability to climate change when exposure and sensitivity are high, and adaptive capacity and resilience are low. Under these circumstances, transformation of the habitat is most likely to occur in upcoming decades.

High: High vulnerability to climate change results from combining either high or moderate exposure-sensitivity with low or medium adaptive capacity-resilience. Under either combination, climate change is likely to have noticeable impact.

Moderate: Moderate vulnerability to climate change results from a variety of combinations for exposure-sensitivity and adaptive capacity-resilience. The number of possible combinations indicates a degree of uncertainty in the vulnerability ranking. Under circumstances where the two factors are essentially balanced, vulnerability is thought to be reduced, but still of concern.

Low: Low vulnerability to climate change occurs when a habitat combines low exposure and sensitivity with high or moderate adaptive capacity and resilience. For these habitats climate change stress and its effects are expected to be least severe or absent.

Results

Patterns of Mid-century Climate Change in Colorado

Climate projections for the 30-year period centered on 2050 indicate that all areas of Colorado will experience some degree of warming (Figures 5-7), and potentially changes in precipitation as well (Figures 8-10). Temperature change projections are regarded as more certain (Barsugli pers. comm.), and there is general agreement that conditions have already warmed to some degree (Lucas et al. 2014). Uncertainty for temperature change is largely regarding the magnitude of the projected change, but climate models are in general agreement about the direction of change.

Precipitation projections for Colorado are more variable than those for temperature. Some models project drier than current conditions and some project wetter. Statewide patterns of precipitation are also variable between models. In combination with expected changes in temperature, however, even a slightly wetter scenario may not be sufficient to maintain soil moisture conditions similar to those of the recent past. This is due to the fact that increased precipitation could be more than offset by warmer temperatures increasing evaporation and transpiration rates.

The climate projections presented here are summaries of long term trends and do not track inter-annual variation, which will remain a source of variability in the future as it has been in the past. It is also important to bear in mind that our analysis focused on a single emission scenario and a limited subset of available global circulation models; at this point in time we have no way of knowing if this is the scenario that will be found valid by mid-century.

Temperature

Statewide, annual mean temperatures under the warmest projected conditions would increase by at least 2°C (3.6°F). In general, mountainous areas, including the San Luis Valley, will warm slightly less (0.2-0.3°C; 0.4-0.5°F) than elsewhere. Temperatures in northeastern and northwestern Colorado are projected to increase by around 2.4°C (4.3°F), with increases of around 2.0°C (3.6°F) in central parts of the state.

Winter temperatures show a similar pattern, with the greatest potential warming (2.6-2.8°C; 4.7-5.0°F) projected for non-mountainous areas in the northern half of the state. Although average winter minimum temperatures remain below freezing statewide, increasing mean winter temperatures are likely to greatly expand the area experiencing winter means above freezing.

Projected increases in summer mean temperatures are greatest on the eastern plains (2.6-3.1°C; 4.7-5.6°F), and are least in mountainous areas under the warmest scenario. Summer minimum temperatures (i.e., warm nights) are also projected to increase. Currently most of Colorado's alpine areas have average summer minimum temperatures that dip below freezing. Under the warmest scenario, these cold summer night temperatures would be largely eliminated from many parts of the state.

Precipitation

In contrast to temperature projections, changes in precipitation could be positive or negative. Under the driest projected conditions, eastern Colorado, the southern San Juan Mountains, and the San Luis Valley could see decreases of 1-4 inches or more in annual precipitation. Under the wettest projected conditions, most areas would experience an increase in annual precipitation, especially the northern and central mountains. Under projected wetter conditions, mountain areas are most likely to see an increase in winter precipitation, and the far eastern plains most likely to see somewhat more summer precipitation. Under projected drier conditions, the greatest decrease in winter precipitation is for the southwestern part of the state, and summer decreases are greatest on the eastern plains. Projected statewide patterns of precipitation are generally similar to those observed in the recent past, but with a slight tendency for eastern and southern parts of the state to be relatively drier than they have been. The local effects of Colorado's complex topography add an additional element of uncertainty to projections of precipitation.

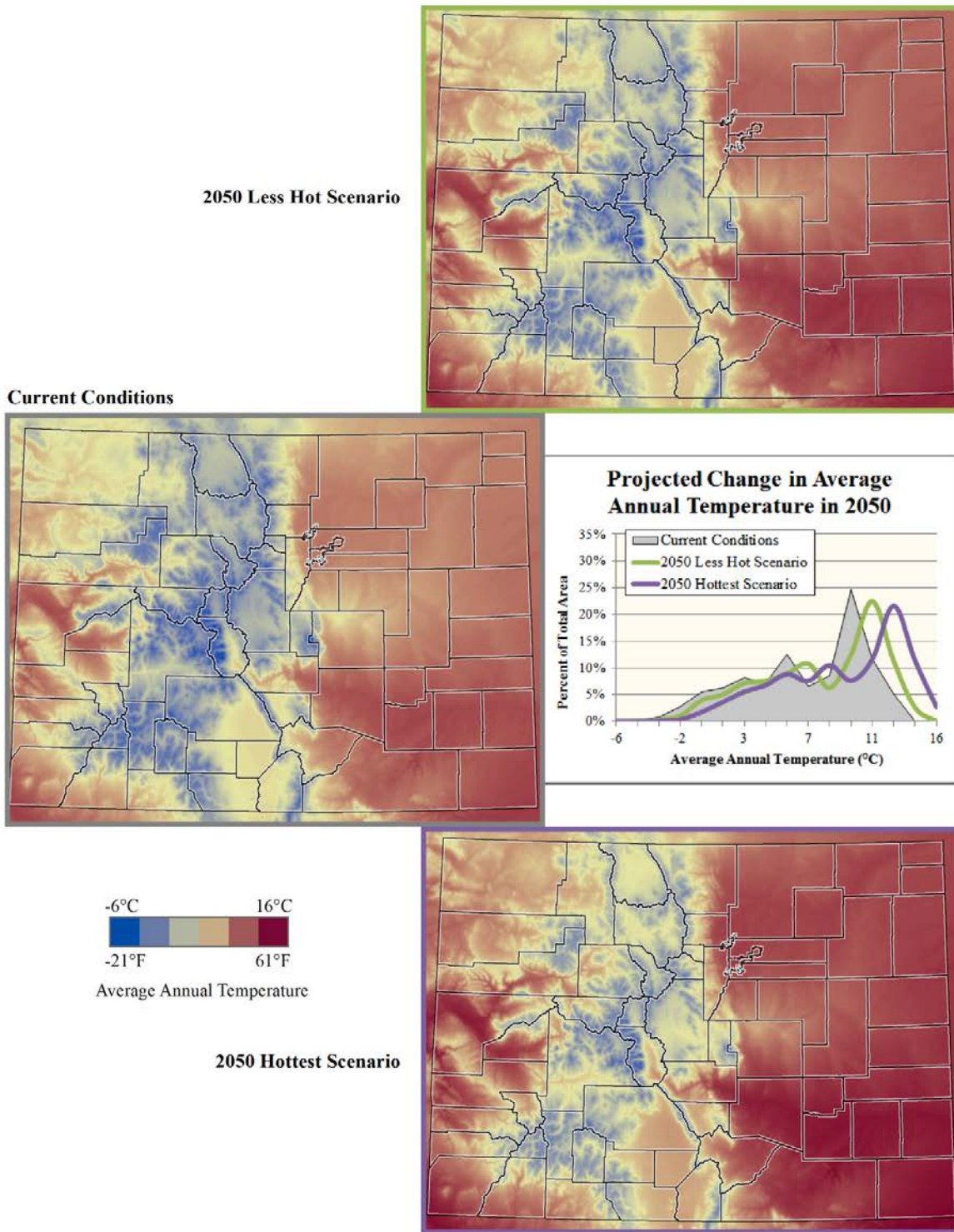


Figure 23. Annual mean temperature, comparison of historic normals with projected conditions at mid-21st century for best and worst case ends of model range.

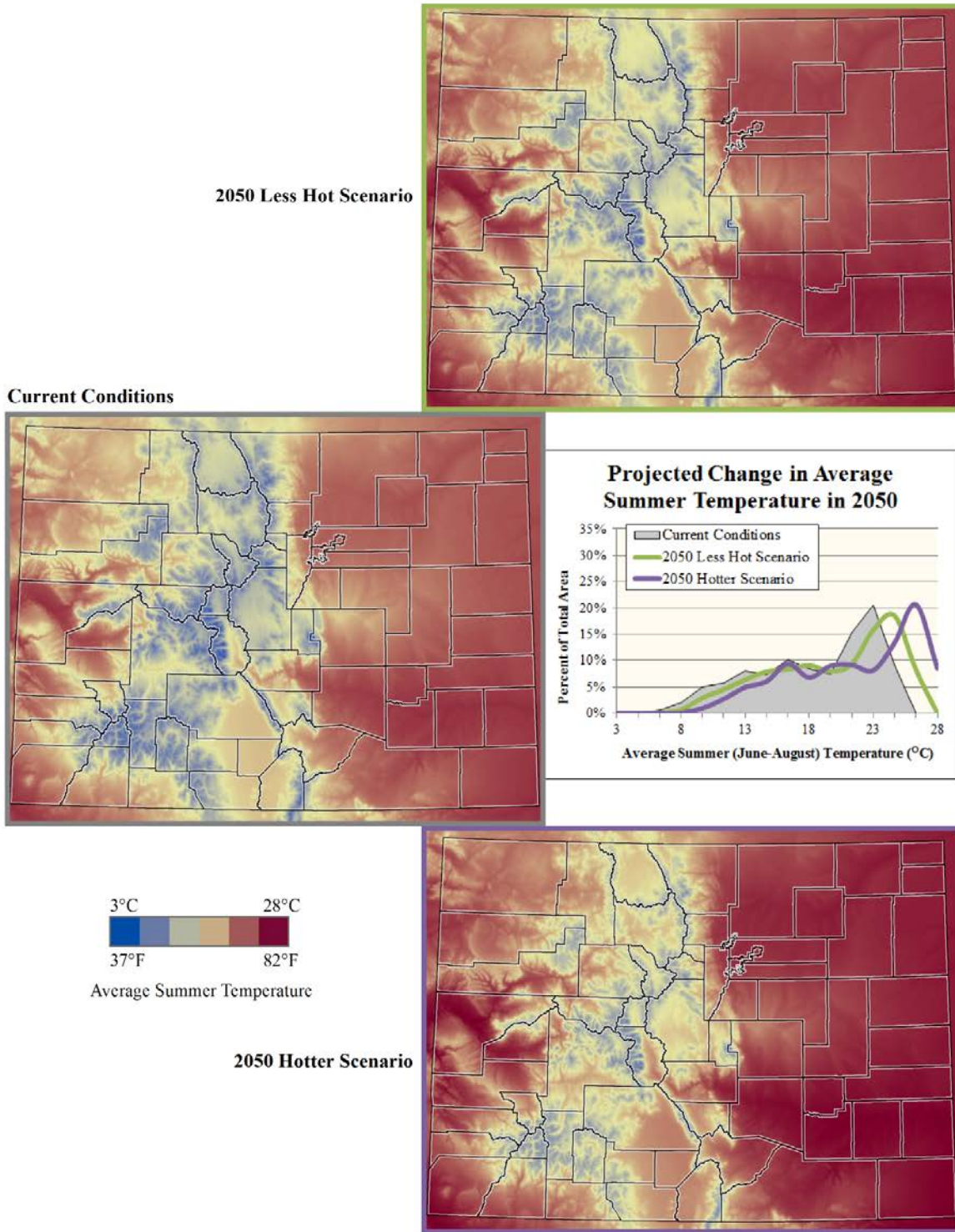


Figure F-6. Mean summer temperature, comparison of historic normals with projected conditions at mid-21st century for best and worst case ends of model range.

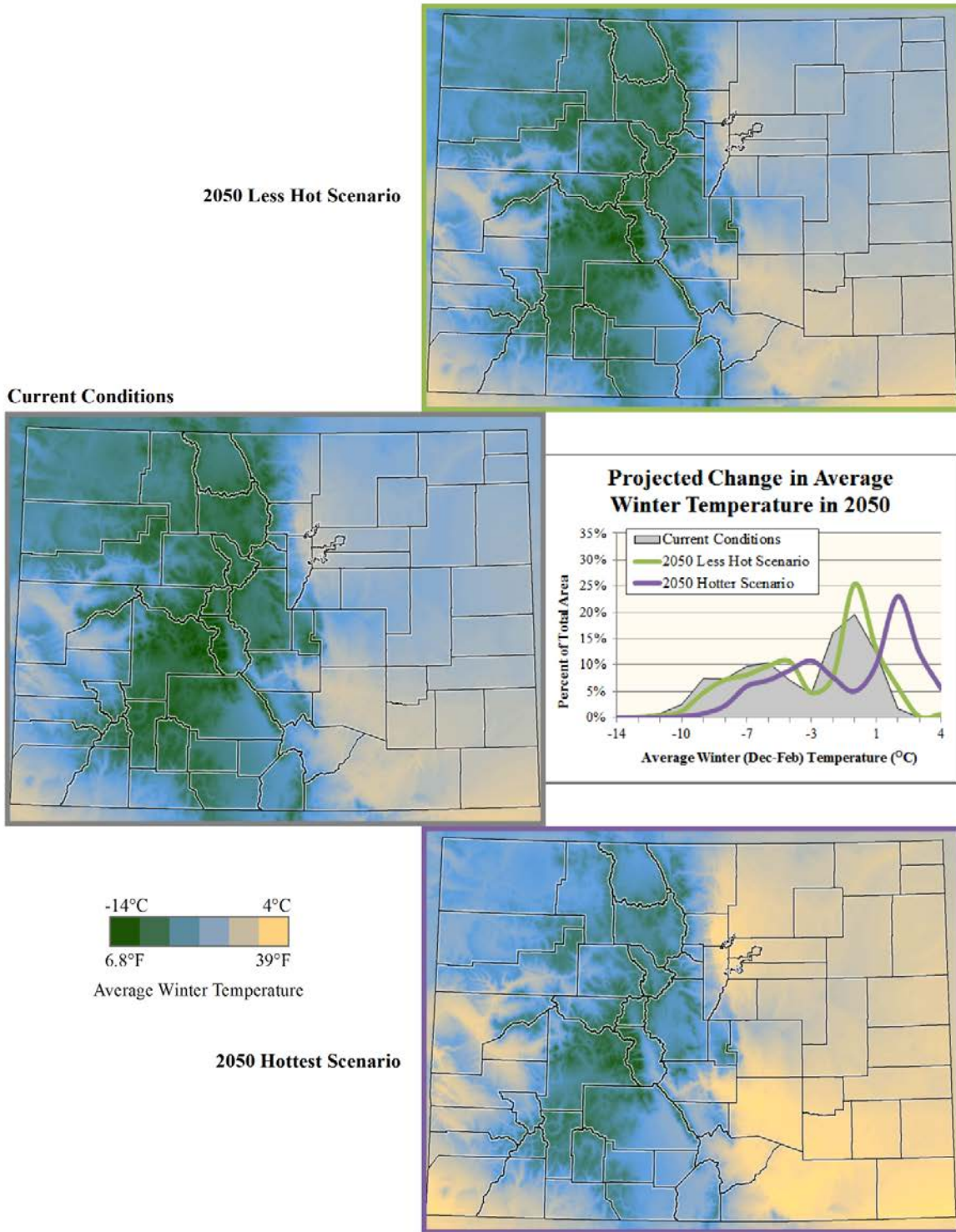


Figure F-7. Mean winter temperature, comparison of historic normals with projected conditions at mid-21st century for best and worst case ends of model range.

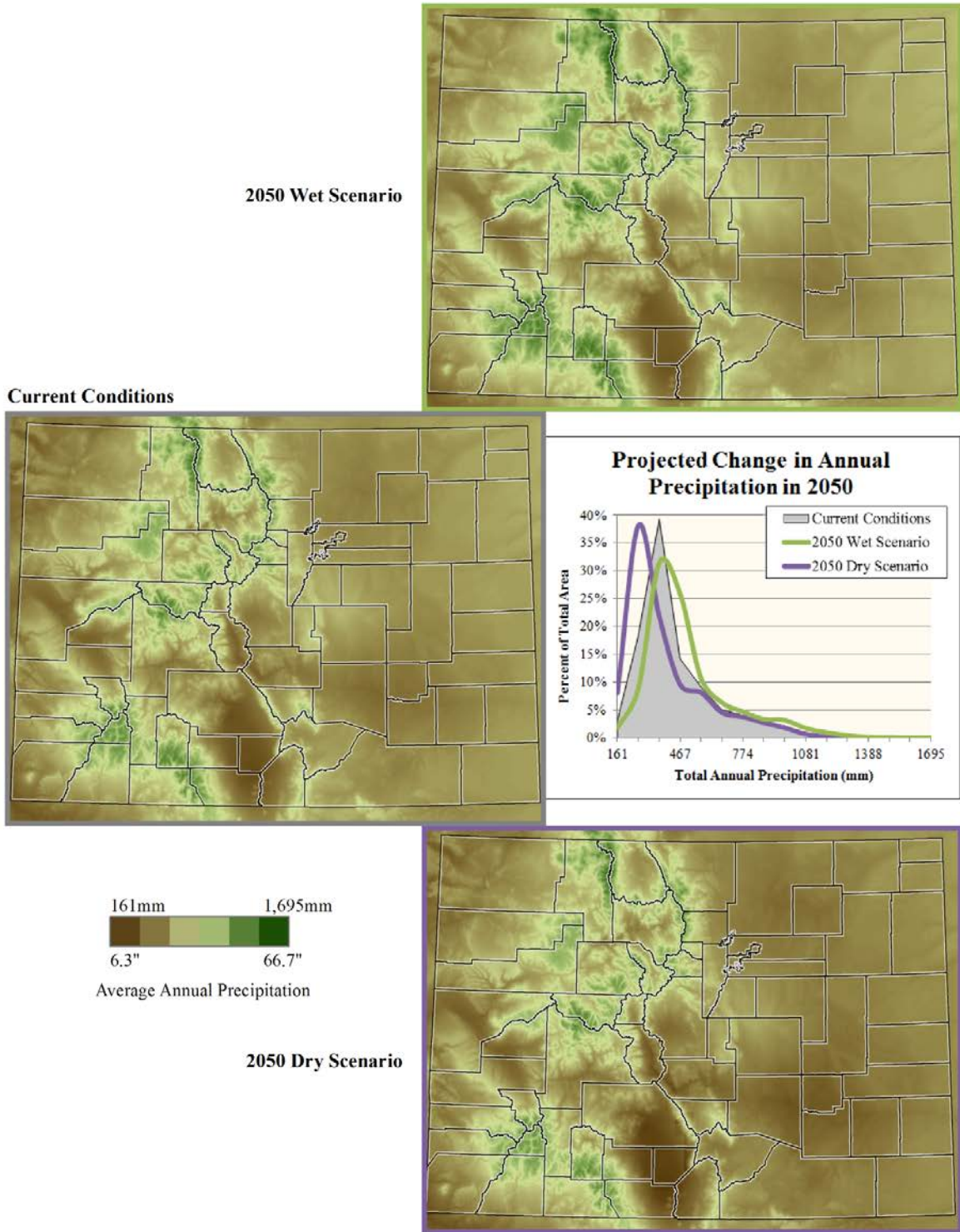


Figure F-8. Annual precipitation, comparison of historic normals with projected conditions at mid-21st century for best and worst case ends of model range.

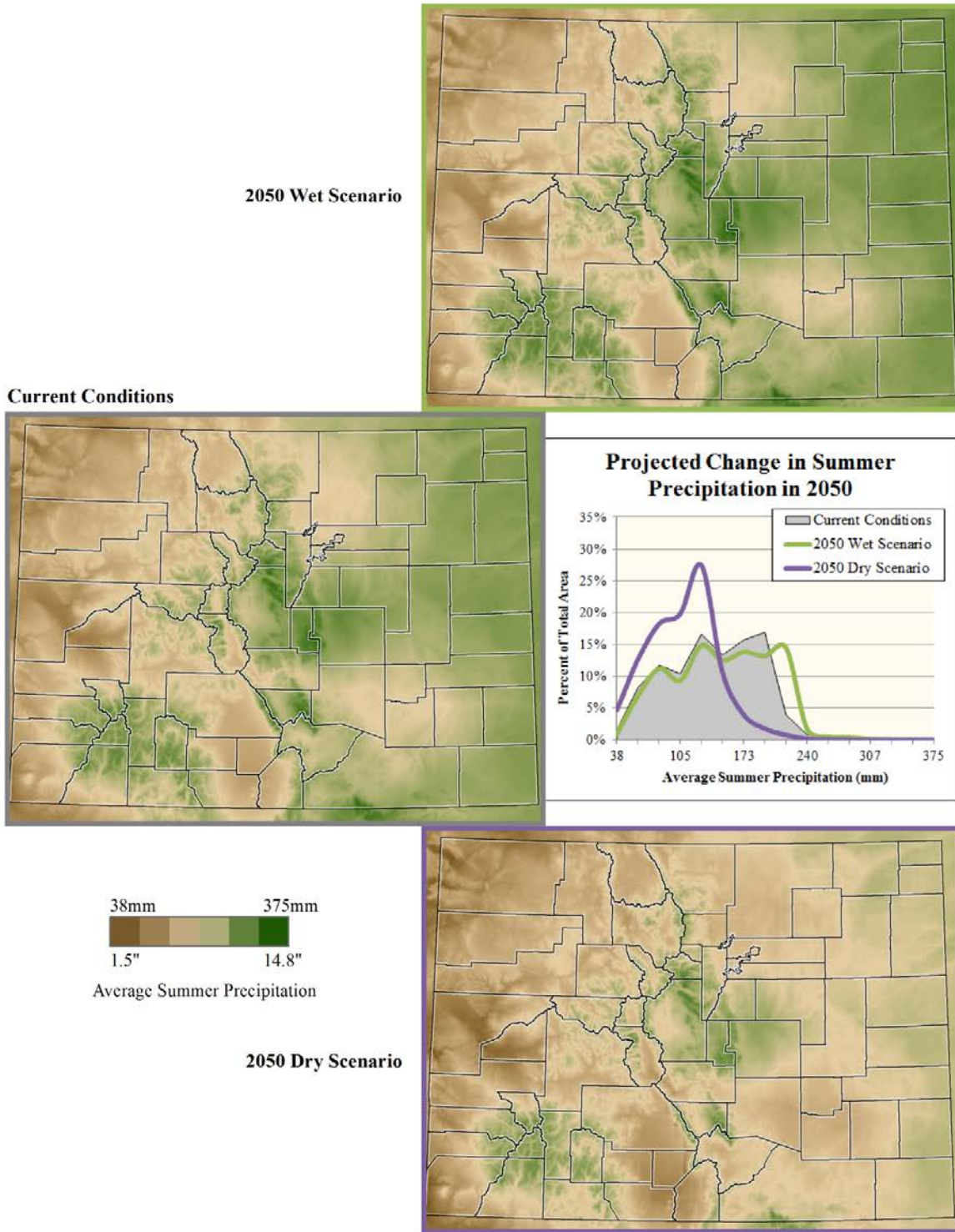


Figure F-9. Summer precipitation, comparison of historic normals with projected conditions at mid-21st century for best and worst case ends of model range.

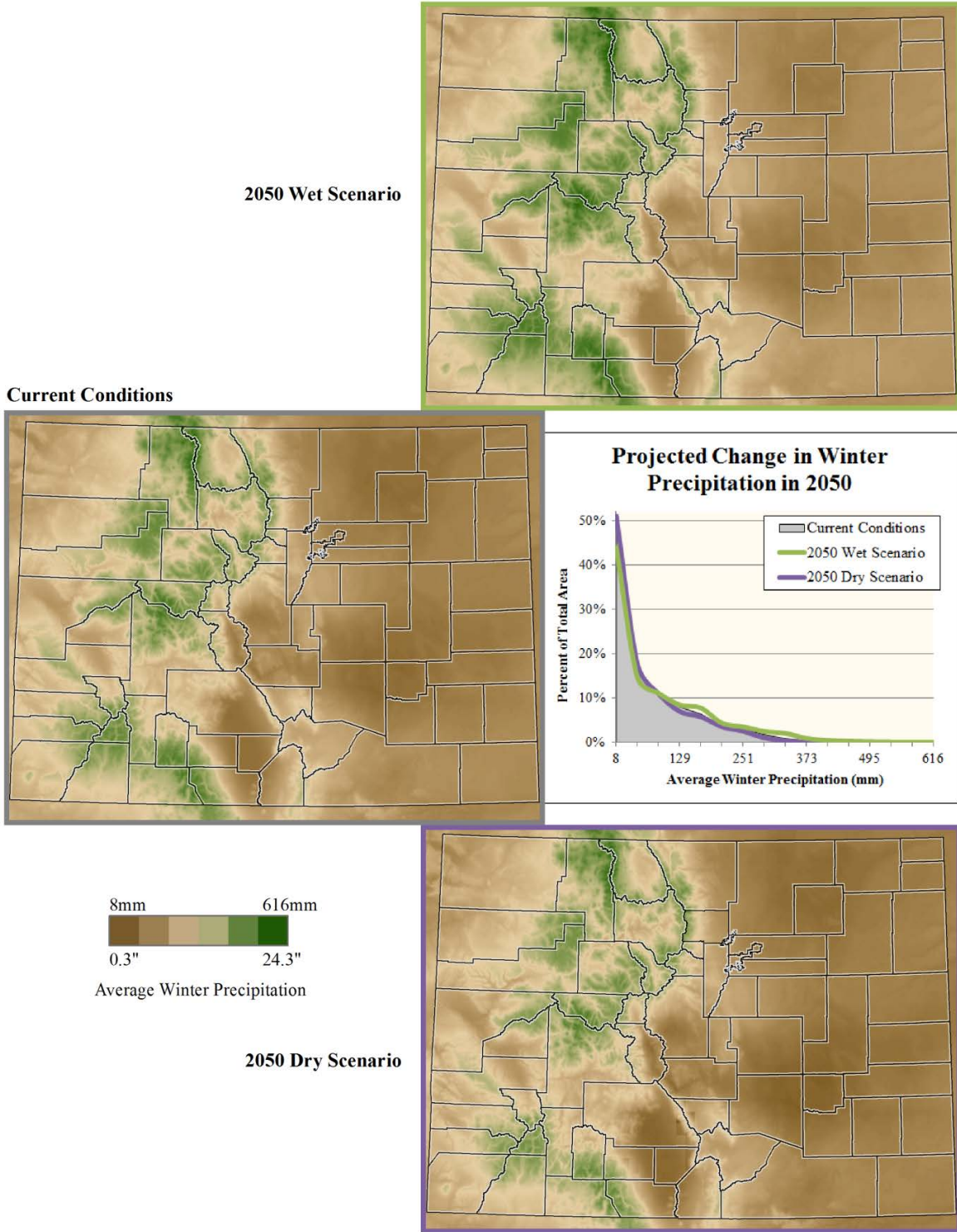


Figure F-10. Winter precipitation, comparison of historic normals with projected conditions at mid-21st century for best and worst case ends of model range.

Habitat-specific Patterns of Mid-century Climate Change

Within the time frame and emissions scenario used for our analysis, the projected climate conditions for our focal habitats indicate that by mid-century habitat envelopes are shifting, but may still be within the range of the constituent species, at least in part. In general, most habitats will not shift quickly, but we will likely begin to see altered composition and potential for novel combinations.

A comparison of the current and projected future climate envelopes for annual patterns of temperature and precipitation (Figure 11) shows that future conditions for most habitats in their currently occupied range will be warmer, but probably still within the range of tolerance for most constituent species. The projected range of future precipitation tends towards wetter for higher elevation habitats, and drier for lower elevation habitats. Habitats of the eastern plains are projected to be drier and warmer.

Seasonal averages for temperature and precipitation show different patterns. The elevational separation of habitats is not evident for summer precipitation, although temperature gradients remain (Figure 12). Warming trends are similar to those seen in the annual summary, but precipitation tends toward drier conditions in comparison with the recent past. Projected changes for winter temperature and precipitation means show less potential warming, and more potential increase in precipitation (Figure 13).

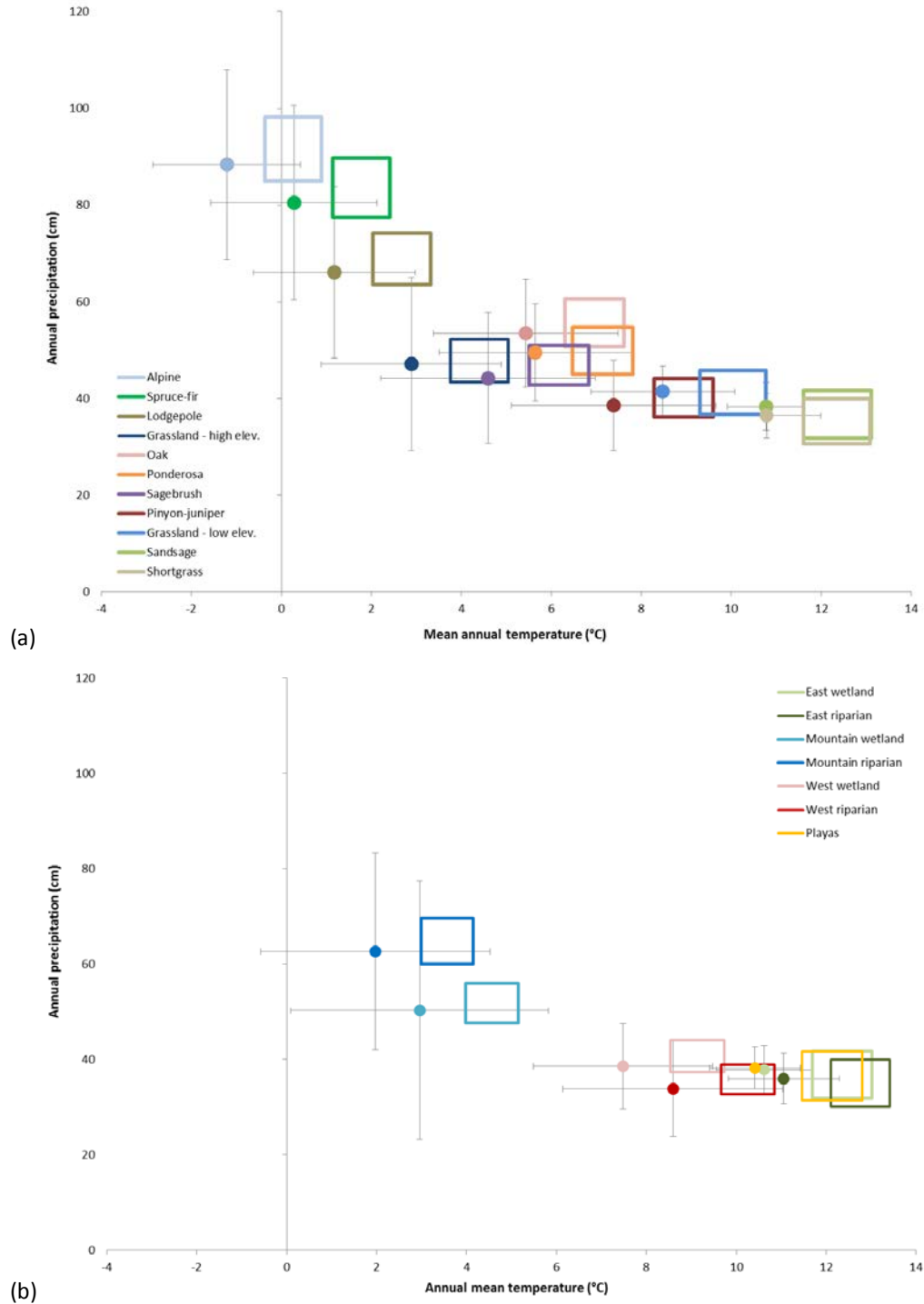
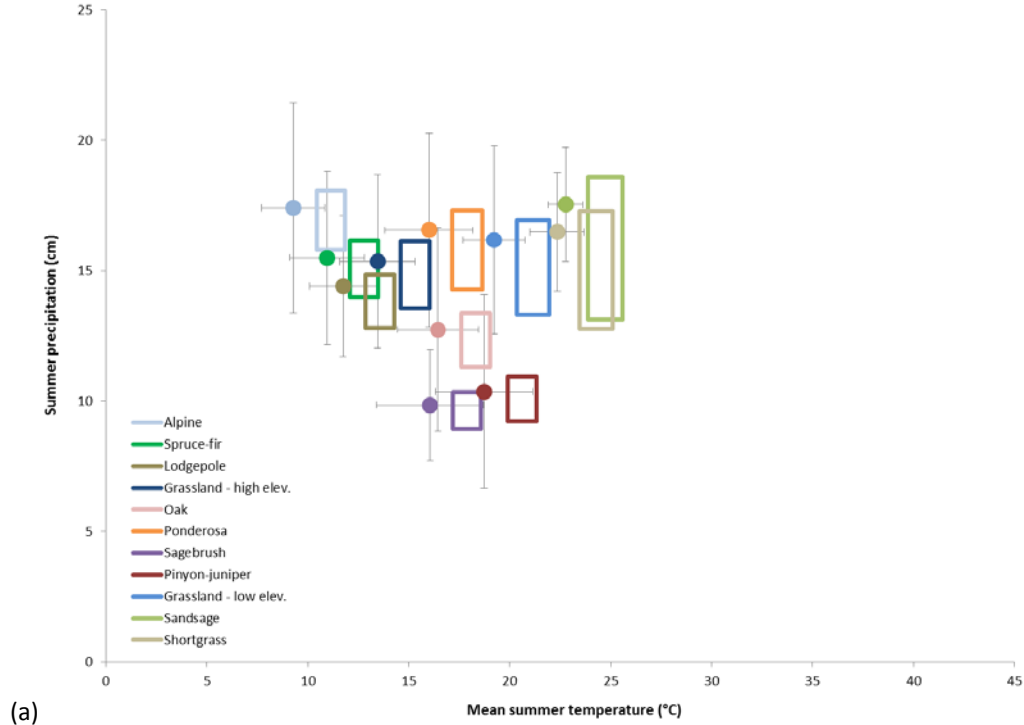
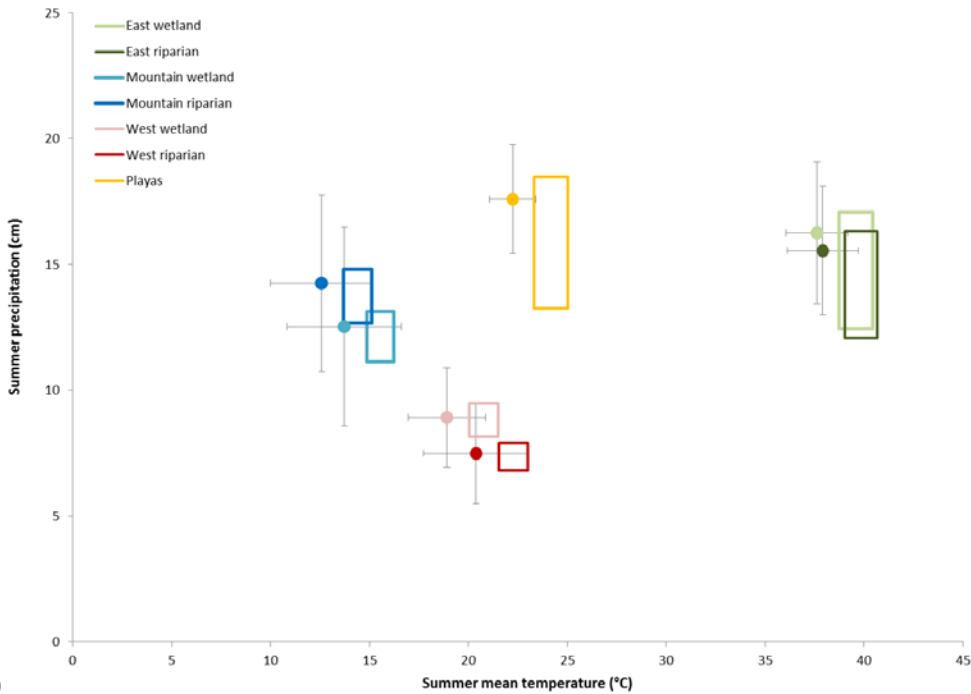


Figure F-11. Current Colorado annual mean temperature and precipitation and projected mid-century region of change for (a) upland habitats and (b) wetland and riparian habitats. Circles represent historic means with error bars representing one std. dev. Squares represent the middle 80% percent of the range of projected mid-century change (12 models under RCP6).



(a)



(b)

Figure F-12. Current Colorado summer mean temperature and precipitation and projected mid-century region of change for (a) upland habitats and (b) wetland and riparian habitats. Circles represent historic means with error bars representing one std. dev. Squares represent the middle 80% percent of the range of projected mid-century change (12 models under RCP6).

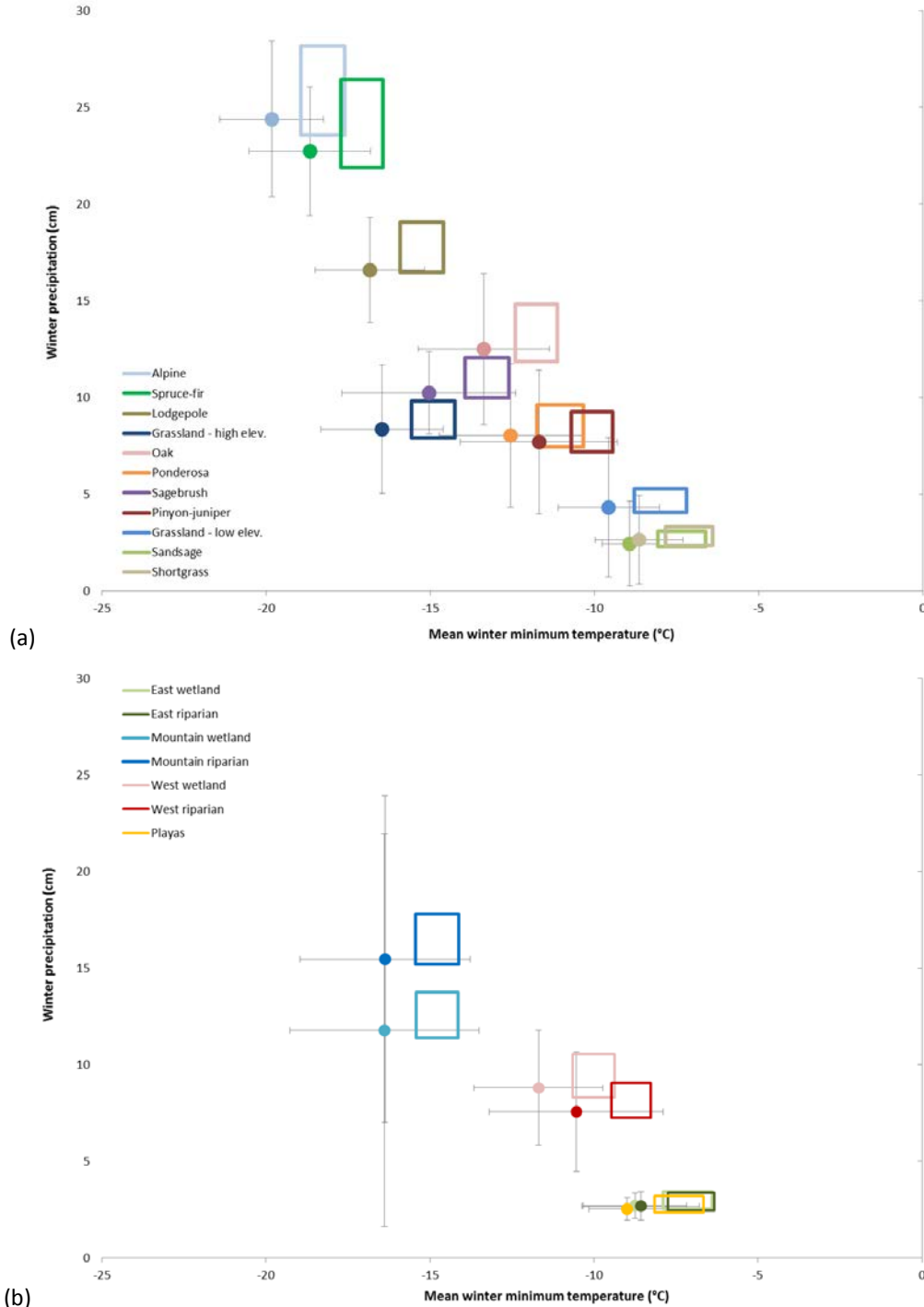


Figure F-13. Current Colorado mean winter minimum temperature and precipitation and projected mid-century region of change for (a) upland habitats and (b) wetland and riparian habitats. Circles represent historic means with error bars representing one std. dev. Squares represent the middle 80% percent of the range of projected mid-century change (12 models under RCP6).

Habitat Vulnerability Ranks

Three of the habitats (or habitat subgroups) assessed have an overall vulnerability rank of High (Table 4). Most habitats were assessed as having moderate resilience. In general, habitats of the eastern plains have the greatest exposure to change, while those of higher elevations are moderately exposed. Under a more severe emissions scenario and a longer time-frame, these habitats would be subject to increased exposure. For example, it is noteworthy that Alpine ranked moderately vulnerable rather than highly vulnerable. This is, at least in part, an artifact of the time period of our analysis. We focused our analysis on mid-century based on the assumption that it represents a realistic planning time frame. However, climate projection scenarios do not really begin to diverge significantly until after the mid-century mark. So although we expect alpine environments to be eliminated from the state in the more distant future, the amount of change by mid-century should be less severe. Additional discussion for individual habitats is provided in the habitat summaries that follow.

Table F-4. Vulnerability rank summary for all assessed habitats.

Habitat Target	Exposure - Sensitivity	Resilience - Adaptive Capacity	Combined Ranks	Overall Vulnerability Rank
Lodgepole pine forest	Low	Low	L/L	Moderate
Pinyon-Juniper woodland	Low	Low	L/L	Moderate
Ponderosa pine forest	Moderate	Moderate	M/M	Moderate
Spruce-Fir forest	Moderate	Moderate	M/M	Moderate
Oak & mixed mountain shrub	Low	High	L/H	Low
Sagebrush shrubland	Low	Moderate	L/M	Low
Sandsage shrubland	High	High	H/H	Moderate
Foothill & mountain grassland - high	Moderate	Moderate	M/M	Moderate
Foothill & mountain grassland - low	High	Moderate	H/M	High
Shortgrass prairie	High	Moderate	H/M	High
Playas	Moderate	Low	M/L	High
Riparian woodland & shrubland - west	Low	Low	L/L	Moderate
Riparian woodland & shrubland - mountain	Low	Moderate	L/M	Low
Riparian woodland & shrubland - east	Low	Moderate	L/M	Low
Wetlands - west	Low	Moderate	L/M	Low
Wetlands - mountain	Low	Moderate	L/M	Low
Wetlands - east	Moderate	Moderate	M/M	Moderate
Alpine	Moderate	Moderate	M/M	Moderate

Conclusions

The majority of habitat types were ranked as moderately vulnerable in our analysis, but the division between moderately and highly vulnerable is less clear than the separation between low and moderate vulnerability (Figure 14). The true vulnerability level of habitats near the moderate-high division is likely to be determined by their degree of adaptive capacity, which we were not able to evaluate with precision, and which can be affected by management actions to some extent.

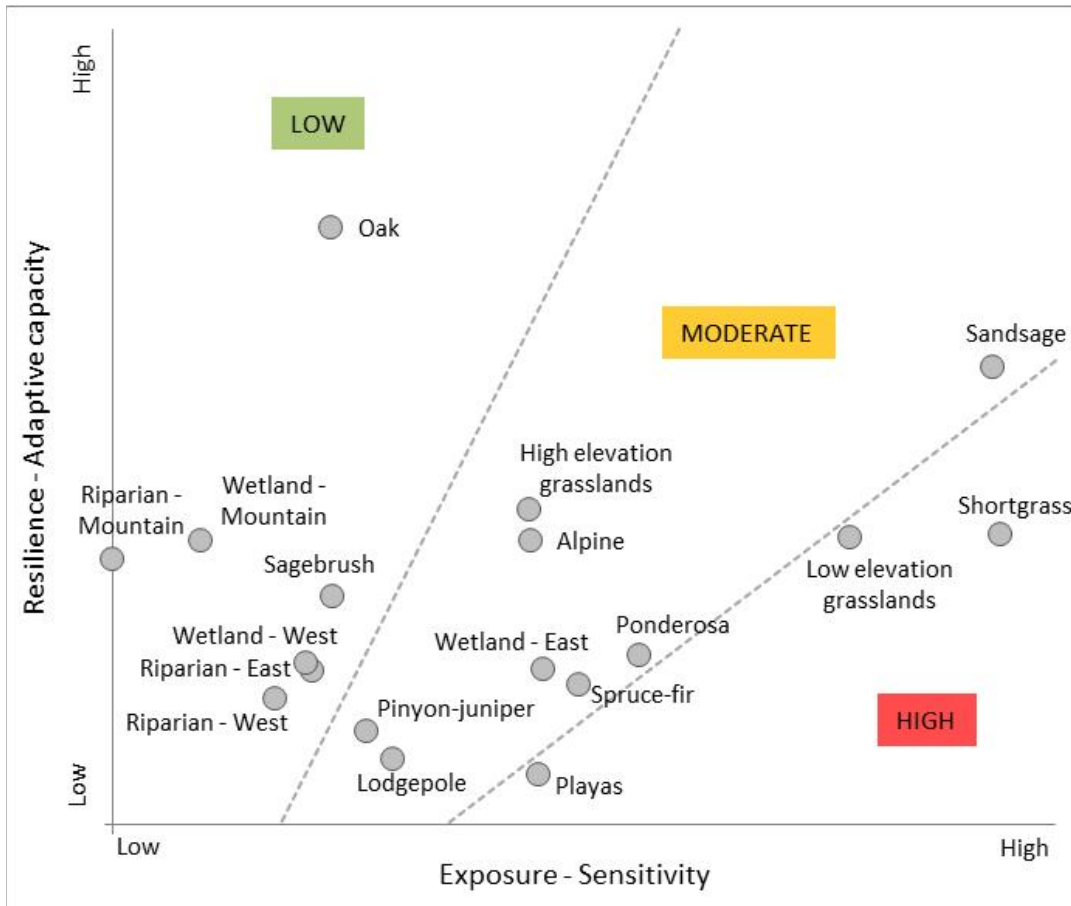


Figure F-14. Exposure-Sensitivity versus Resilience-Adaptive capacity scores for habitats included in this evaluation. Vulnerability ranks of Low, Moderate, and High are relative categories indicating an approximate priority of each habitat for management and planning for climate change.

By mid-century, under a medium-high emissions scenario (RCP6.0), we can expect to see warmer temperatures statewide, especially on the eastern plains. Warmer temperatures are likely to include more heat waves, fewer cold snaps, and generally extended frost-free periods. Although these conditions could benefit many species if precipitation remains adequate, the warming trend is likely to be accompanied by drier conditions in many areas. Even if

precipitation levels at higher elevations are essentially unchanged, warmer conditions will lead to more precipitation falling as rain instead of snow, a decreased snowpack, earlier runoff, and earlier dry conditions in late summer (Lucas et al. 2014). All of these factors may interact with stressors such as fire, forest pests and diseases, drought, and anthropogenic disturbance to alter the future trajectory of a particular habitat.

Comparison of the current range of climate variables with the projected range (Figures 11-13 above) indicates substantial current and future overlap of climatic conditions for some habitat groups. For instance, alpine, spruce-fire, and, in some cases lodgepole pine, are clearly close in climatic tolerance, while ponderosa pine, oak-shrub, and sagebrush form a group sharing similar climatic conditions at lower elevations. The interaction of climatic conditions with other environmental factors and biogeographic history shapes the distribution of habitats that we currently observe. Furthermore, the time lag between when climate conditions become suitable or unsuitable for a species and the eventual colonization or elimination of that species in an area adds another level of uncertainty to projections of future habitat distribution. Climate changes over the past few decades are probably already facilitating a gradual shift of habitats that will become more apparent by mid-century.

Our analysis of the range of future uncertainty focused on “worst case” outcomes in order to provide a vulnerability prioritization of key habitats that will facilitate a pragmatic “no-regrets” planning strategy for CPW staff dealing with the ongoing effects of climate change in Colorado.

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LODGEPOLE

Climate Influences

Lodgepole pine (*Pinus contorta*) is a northern species that does exceptionally well in very cold climates and can tolerate a wide range of annual precipitation patterns, from fairly dry to fairly wet, but generally grows only where annual precipitation is at least 18-20 inches (Mason 1915, Lotan and Perry 1983). Lodgepole pine forests are found on drier sites than spruce-fir forest, although snowfall is typically heavy in these forests. Summers are often quite dry, and lodgepole pine is dependent on snowmelt moisture for most of the growing season. In low snowpack years, growth is reduced (Hu et al. 2010).

Lodgepole pine is tolerant of very low winter temperatures, and in many lodgepole forests summer temperatures can fall below freezing, so there is no true frost-free season (Lotan and Perry 1983). Lodgepole pine is also able to take advantage of warm growing season temperatures, and a longer growing season due to warmer fall temperatures could favor the growth of lodgepole pine (Villalba et al. 1994, Chhin et al. 2008). In southern Colorado, white fir (*Abies concolor*) appears to take the place of lodgepole pine in coniferous forests of similar elevations. White fir appears to tolerate warmer temperatures than lodgepole pine (Thompson et al. 2000); under warmer conditions it may be able to move into areas currently occupied by lodgepole forest.

Exposure and Sensitivity Summary

Lodgepole pine forests are projected to experience winter temperatures warmer than the current in about one quarter of the current distribution. Projected winter and spring precipitation levels are generally within the current range, but summer precipitation for 21% of the current distribution is projected to be lower than the driest end of the current range.

Lodgepole

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Winter precipitation (L)	0%
Spring precipitation (M)	3%
Summer precipitation (M)	21%
Mean winter temperature (E)	25%
Very cold days (E)	25%
Average range shift	14.9%
Rank	L
Exposure-Sensitivity level	Low

Resilience Components

Lodgepole pine subspecies are widely distributed in North America, but Rocky Mountain lodgepole reaches the southern edge of its distribution in south-central Colorado. In Colorado, lodgepole pine forests range from about 8,500-11,000 ft. in elevation. Statewide, the annual average precipitation range is about 13.5-41 in. (35-105 cm), with a mean of 25 in. (64 cm). Lodgepole pine is able to tolerate much warmer temperatures than spruce-fir forest. Growing season length for lodgepole broadly overlaps that of the warmer end of the spruce-fir distribution.

Many lodgepole forests developed following fires. Lodgepole pines produce both open and serotinous cones, and can reproduce quickly after a fire. Following stand-replacing fires, lodgepole pine rapidly colonizes and develops into dense, even-aged stands (sometimes referred to as “dog hair” stands). This fire-adapted species has the potential to move into areas where spruce-fir forests burn.

Although invasive species are generally not a factor, lodgepole forests are vulnerable to the pest outbreaks that appear to increase with warmer, drier, drought-prone climates. Biological stressors that interact with fire dynamics of lodgepole forest include infestations of lodgepole pine dwarf-mistletoe and mountain pine beetle (Anderson 2003). Dwarf mistletoe reduces tree growth and cone production, and generally leads to earlier mortality (Hawksworth and Johnson 1989). Although lodgepole forests are still common across Colorado, most are experiencing widespread damage from a severe outbreak of mountain pine beetle. The pine beetle is a native species, and periodic outbreaks of this insect are part of the natural cycle that maintains

Colorado's mountain forests. Lodgepole forests are expected to persist in Colorado (Kaufmann et al. 2008).

Adaptive Capacity Summary

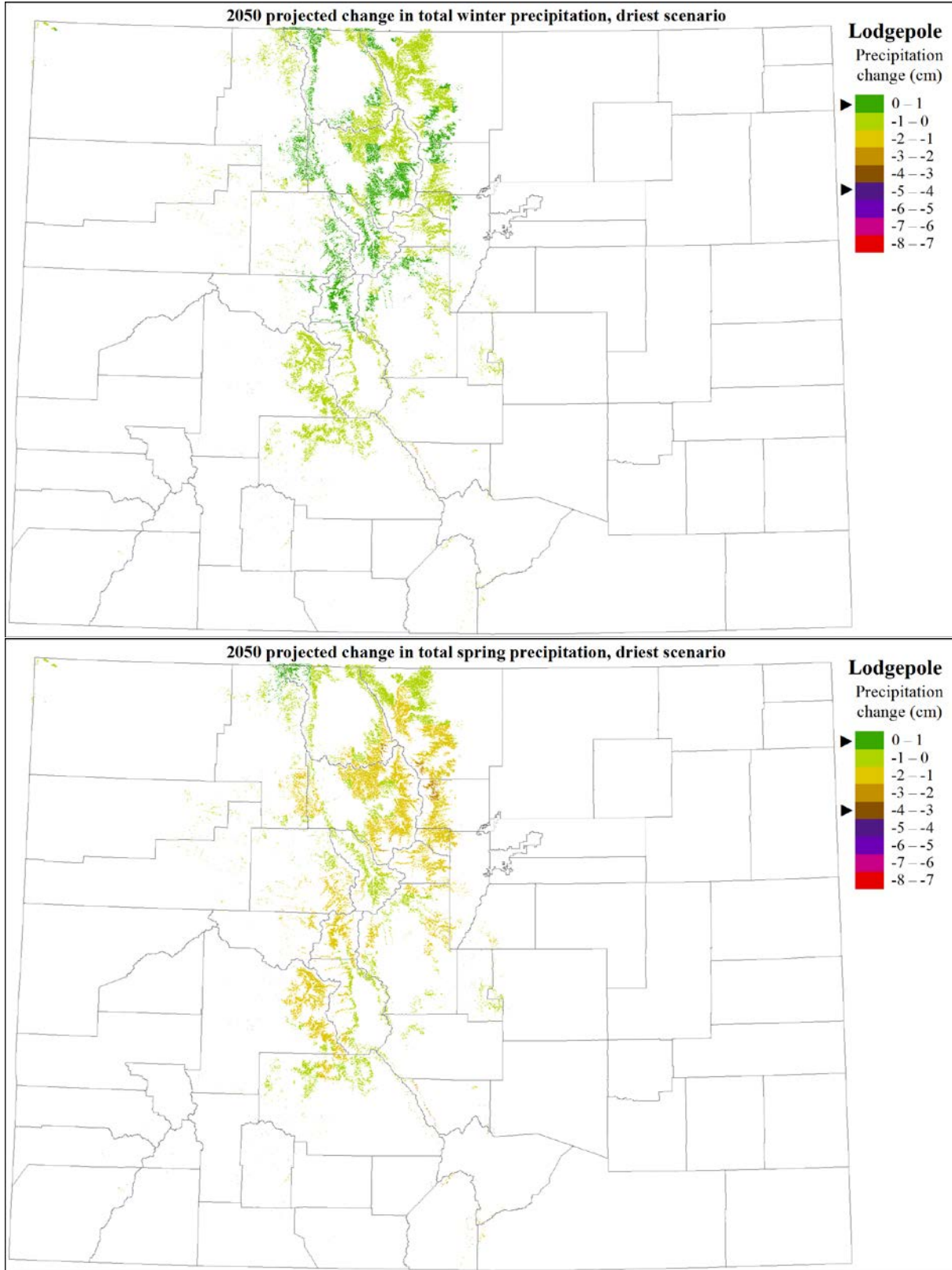
	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Lodgepole	0.60	0	0.67	0.33	0.75	0.45	L	Low

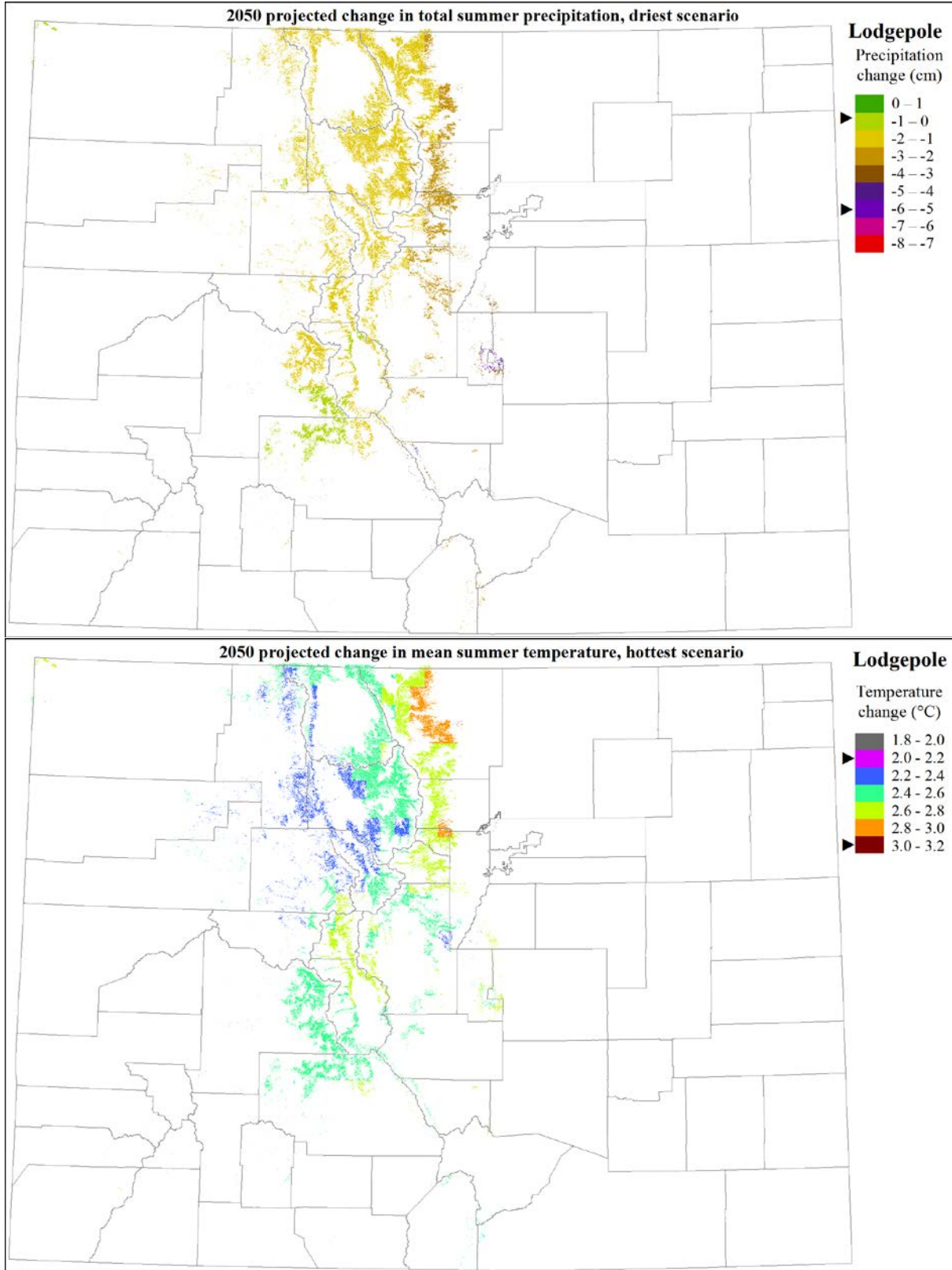
Vulnerability to Climate Change

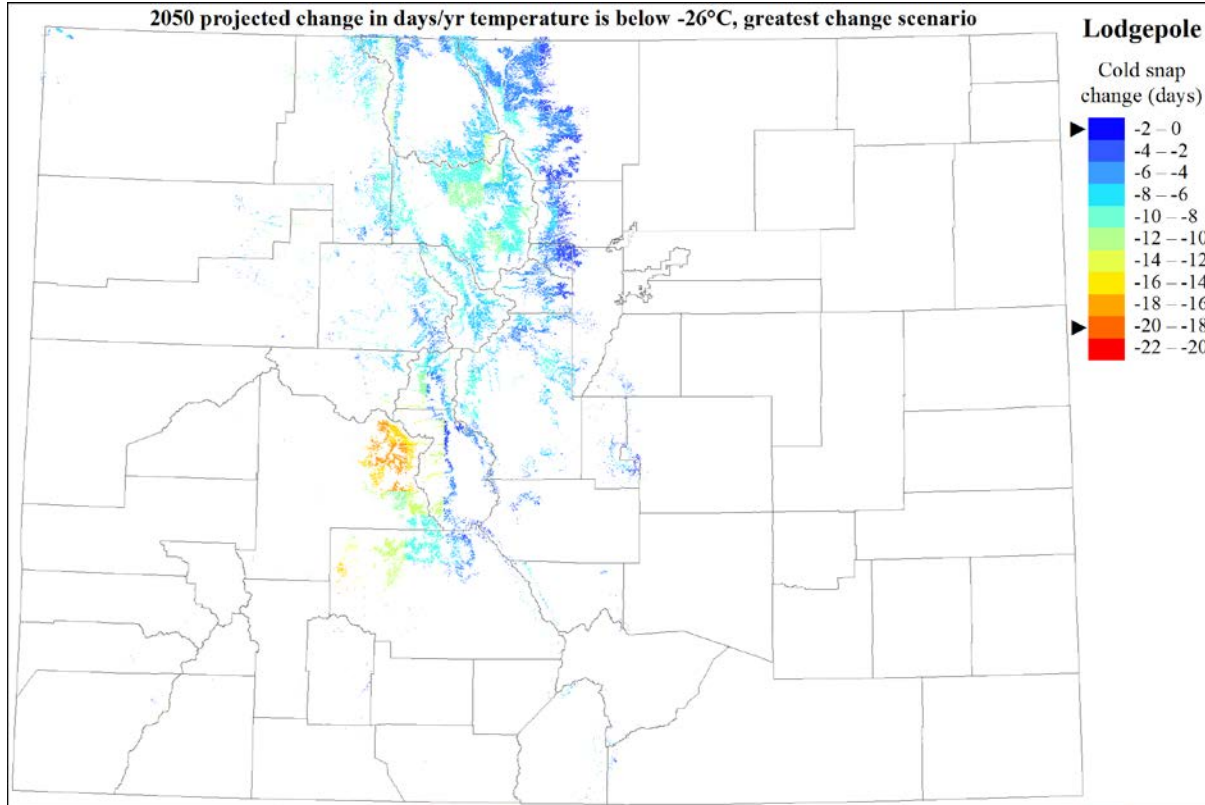
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Lodgepole pine forest	Low	Low	L/L	Moderate

Lodgepole pine forest is ranked moderately vulnerable to the effects of climate change by mid-century under a moderate emissions scenario. Primary factors contributing to this ranking are its vulnerability to forest disturbances that may increase in the future, and the fact that it is at the southern edge of its distribution in Colorado.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for lodgepole pine forest. Legend pointers indicate the range of change for this habitat within the statewide extent of change. For winter precipitation, areas in the southern and western edge of the Colorado distribution are most exposed. For spring and summer precipitation, areas along the Front Range are most exposed to drier conditions. Warming during the growing season is projected to experience the greatest increase in the eastern portion of the Colorado distribution, and the number of very cold days in winter is projected to reduce the most in the south-western part of the distribution.







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PINYON-JUNIPER

Climate Influences

These evergreen woodlands are adapted to cold winter minimum temperatures and low rainfall, and are often transitional between grassland or desert shrubland and montane conifer ecosystem (Brown 1994, Peet 2000). Since the last major glacial period, the distribution and relative abundance of the characteristic tree species has fluctuated dynamically with changing climatic conditions. Warming conditions during the past two centuries, together with changing fire regime, livestock grazing, and atmospheric pollution increased the ability of this ecosystem to expand into neighboring communities, at both higher and lower elevations (Tausch 1999). Variable disturbance and site conditions across the distribution of this ecosystem have resulted in a dynamic mosaic of interconnected communities and successional stages that may be naturally resilient.

Barger et al. (2009) found that pinyon pine (*Pinus edulis*) growth was strongly dependent on sufficient precipitation prior to the growing season (winter through early summer), and cooler June temperatures. Both of these variables are predicted to change in a direction that is less favorable for pinyon pine. Drought can result in widespread tree die-off, especially of the more susceptible pinyon pine (Breshears et al. 2008). Clifford et al. (2013) detected a strong threshold at 60 cm cumulative precipitation over a two-year drought period (i.e., essentially normal annual precipitation for pinyon pine). Sites above this threshold experienced little pinyon die-off, while sites receiving less precipitation included areas with high levels of mortality. Mortality of pinyon trees was extensive in the area during the 2002-2003 drought and bark beetle outbreak, but in areas where juniper (*Juniperus* spp.) and shrub species provide microsites for seedling establishment, pinyon may be able to persist (Redmond and Barger 2013). Patterns of precipitation and temperature (i.e., cool, wet periods) appear to be more important in recruitment events than history of livestock grazing (Barger et al. 2009).

The pinyon-juniper habitat has large ecological amplitude; warmer conditions may allow expansion, as has already occurred in the past centuries, as long as there are periodic cooler, wetter years for recruitment. Increased drought may drive fires and insect outbreaks, from which these woodlands would be slow to recover.

Exposure and Sensitivity Summary

Pinyon-juniper woodlands are projected to experience summer temperatures warmer than the current range in more than one third of the current distribution. Projected winter precipitation

levels are generally within the current range, but spring and summer precipitation for 9-16% of the current distribution are projected to be lower than the driest end of the current range.

Pinyon-juniper

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Winter precipitation (L)	2%
Spring precipitation (M, L)	16%
Summer precipitation (M, E, L)	9%
Mean summer temperature (M, E)	38%
Very cold days (M, E)	3%
Average range shift	13.5%
Rank	L
Exposure-Sensitivity level	Low

Resilience Components

Pinyon-juniper, which forms the characteristic woodland of warm, dry lower elevations from about 4,600 to 8,500 ft., is widespread in Colorado's western canyons and valleys, as well as in the southern mountains. The North American distribution of this habitat is centered in the Colorado Plateau, generally southwest of Colorado. Stands are often adjacent to and intermingled with oak, sagebrush, or saltbush shrubland. The statewide range of annual average precipitation is about 10-23 in (25-60 cm), with a mean of 16 in (40 cm), similar to sagebrush shrubland. Growing season temperatures are greater in the range of pinyon-juniper than for many other woody vegetation types in Colorado.

Extended drought can increase the frequency and intensity of insect outbreaks and wildfire. Pinyon are susceptible to the fungal pathogen *Leptographium wageneri* var. *wageneri*, which causes black stain root disease, and to infestations of the pinyon ips bark beetle (*Ips confusus*) (Kearns and Jacobi 2005). The differential susceptibility of pinyon and juniper could eventually result in these woodlands being dominated by juniper.

Pinyon pine stands are slow to recover from intense fires; the species reproduces only from seed and recovery is dependent on seed sources and/or adequate dispersal. Junipers are also slow-growing, and susceptible to being killed by fire. At Mesa Verde National Park, where pinyon-juniper woodlands have burned in five large fires since 1930, trees have not yet re-established. It is not known why trees have not been successful in these areas, which are now occupied by shrubland (Floyd et al. 2000).

Adaptive Capacity Summary

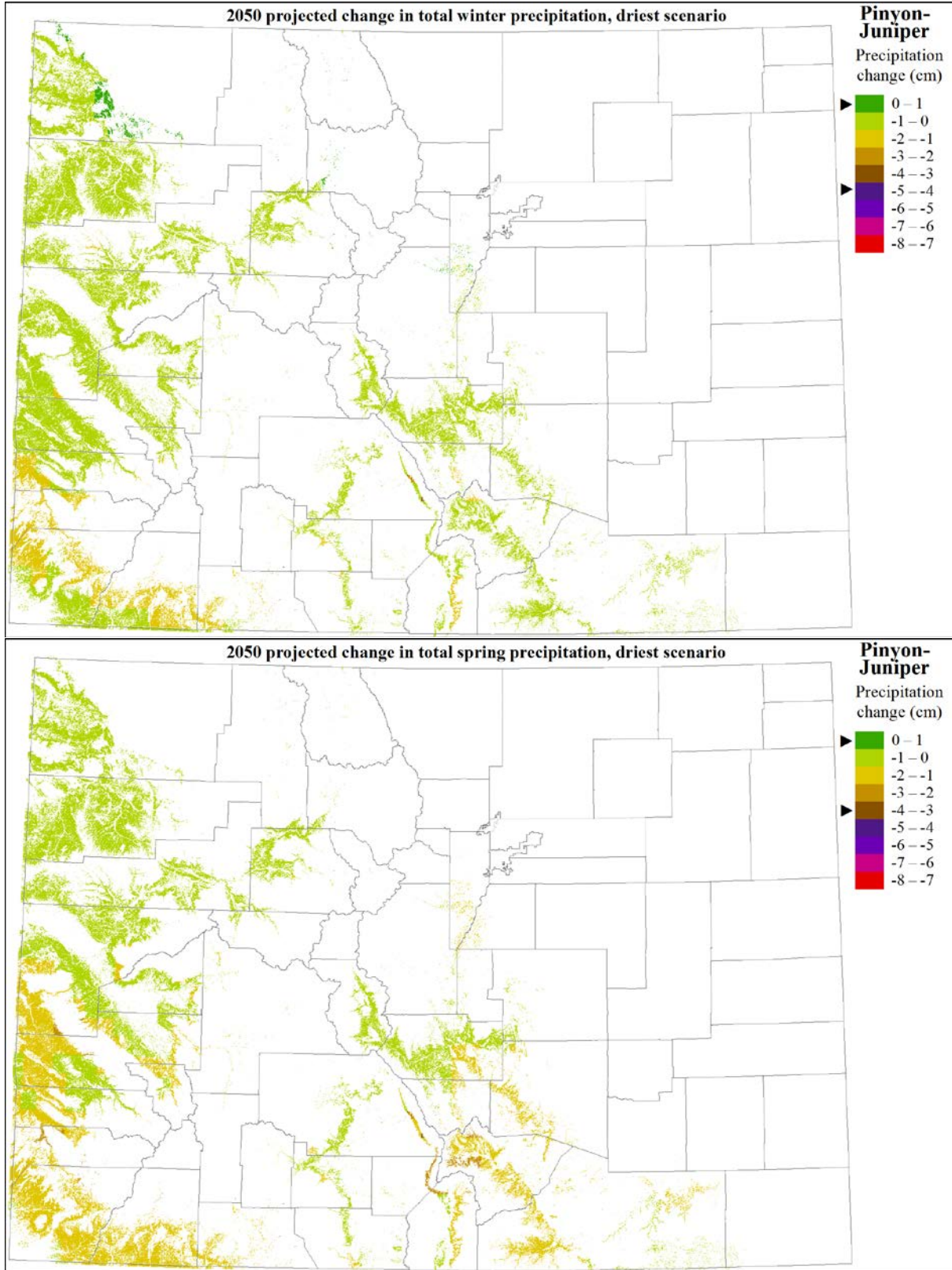
	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Pinyon-juniper	0.87	0	0.67	0.33	0.592	0.47	L	Low

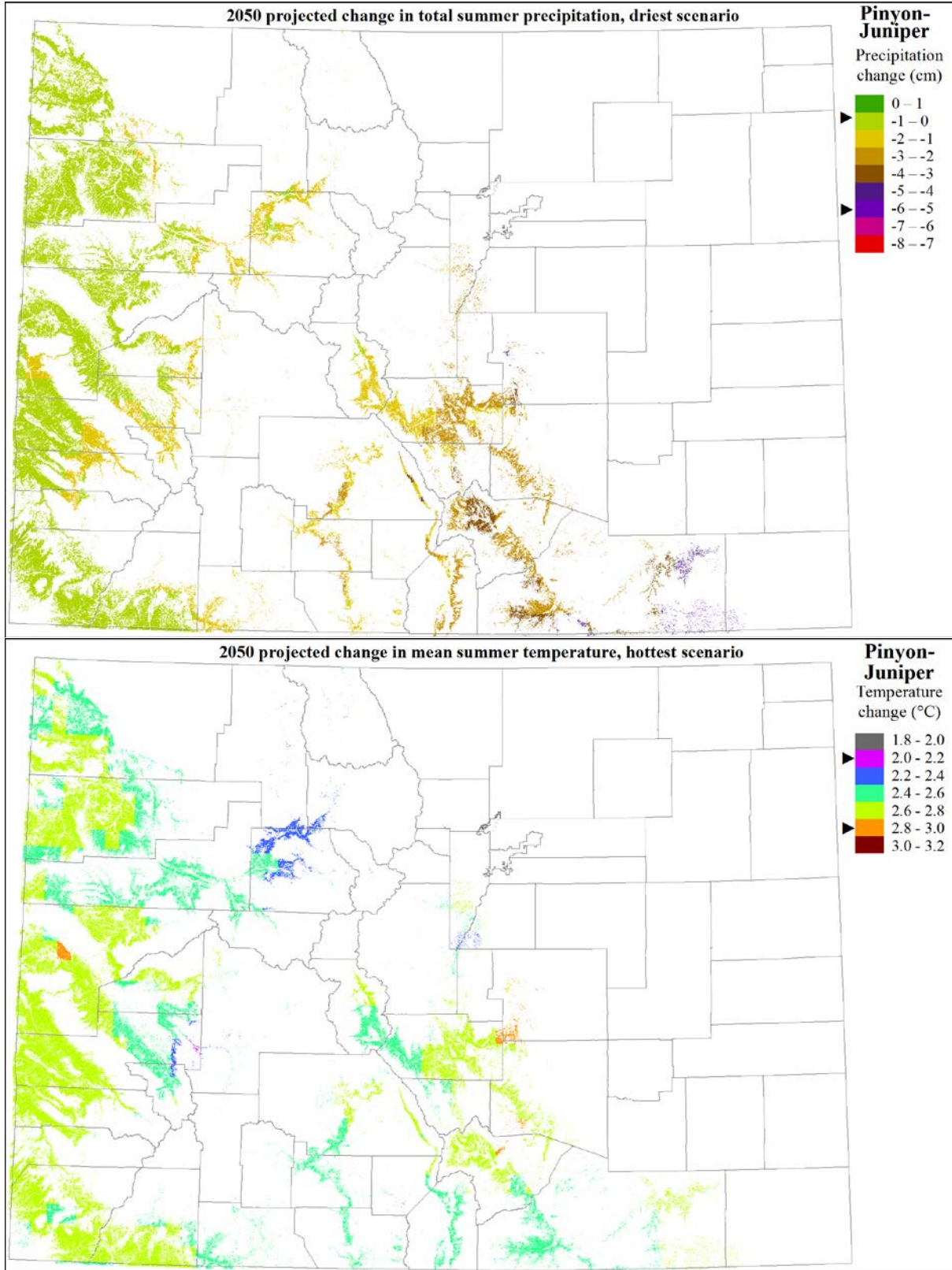
Vulnerability to Climate Change

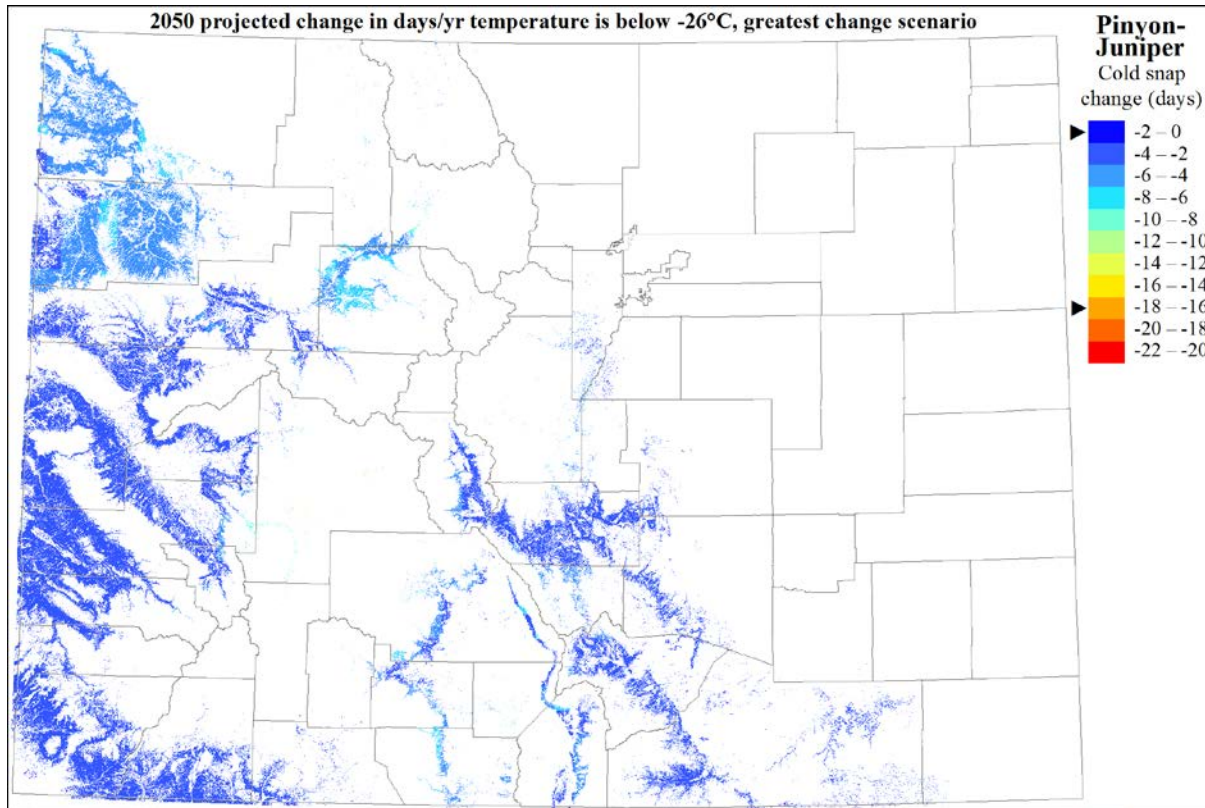
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Pinyon-Juniper woodland	Low	Low	L/L	Moderate

Pinyon-juniper woodlands are ranked moderately vulnerable to the effects of climate change by mid-century under a moderate emissions scenario. Primary factors contributing to this ranking are the vulnerability of these woodlands to stressors that are likely to increase under changing climate, and the extent to which the current landscape condition of the habitat has been impacted by anthropogenic disturbance.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for pinyon-juniper. Legend pointers indicate the range of change for this habitat within the statewide extent of change. Areas in the southern part of the state are most exposed to potentially drier conditions, especially for summer precipitation. Temperature change does not show a clear pattern.







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PONDEROSA

Climate Influences

Ponderosa pine (*Pinus ponderosa*) occupies relatively dry, nutrient-poor sites compared to other montane conifers, but shows wide ecological amplitude throughout its distribution. Rehfeldt et al. (2012) were able to predict the distribution of ponderosa pine largely through the use of summer and winter precipitation, and summer temperatures (as growing degree days >5 C). Periodic seasonal drought is characteristic across the range of ponderosa pine; this species is generally found where annual precipitation is at least 13 inches (Barrett et al. 1980, Thompson et al. 2000). Ponderosa stands to the south of Colorado were primarily reliant on winter precipitation (Kerhoulas et al. 2013), while growth of Front Range stands was correlated with spring and fall moisture (League and Veblen 2006), indicating some variability in the ability of ponderosa pine to take advantage of seasonal water availability, depending on site factors and stand history. Consequently, vulnerability of ponderosa forests to changes in precipitation patterns may differ according to their location in Colorado.

Ponderosa pine is able to tolerate fairly warm temperatures as long as there is enough moisture, especially in the growing season. Optimal germination and establishment conditions occur when temperatures are above 50°F and monthly precipitation is greater than 1 inch (Shepperd and Battaglia 2002). Significant recruitment events may occur on burned areas when conditions are wetter than normal after a fire year, but normal precipitation may also be sufficient for seedling establishment in such cases (Mast et al. 1998). In lower elevation ponderosa woodlands of the Colorado Front Range, episodic recruitment of ponderosa pine was associated with high spring and fall moisture availability during El Niño events (League and Veblen 2006). A correlation between drought and low rates of ponderosa seedling recruitment has also been identified throughout the western Great Plains (Kaye et al. 2010). Drought in combination with future projected higher temperatures is likely to reduce ponderosa pine regeneration, especially in drier, lower elevation areas. The work of Brown and Wu (2005) suggests that coincident conditions of sufficient moisture and fewer fires are important for widespread recruitment episodes of ponderosa pine; such conditions may become less likely under future climate scenarios.

Increased drought may drive fires and insect outbreaks. Relative proportions of associated species (e.g., other conifers, aspen, understory shrubs and grasses) in ponderosa stands may change. This habitat is well adapted to warm, dry conditions if precipitation is not too much reduced, and may be able to expand into higher elevations.

Exposure and Sensitivity Summary

Ponderosa pine forests and woodlands are projected to experience summer temperatures warmer than the current range in more than one third of the current distribution, and projected winter temperatures warmer than the current range for more than a quarter of the distribution. Projected summer and fall precipitation levels are projected to be lower than the driest end of the current range for nearly a quarter of the current distribution.

Ponderosa

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Summer precipitation (M, E, L)	19%
Fall precipitation (L)	23%
Mean winter minimum temperature (M, E)	27%
Mean summer temperature (E)	39%
Very hot days (E)	32%
Average range shift	19.2%
Rank	M
Exposure-Sensitivity level	Moderate

Resilience Components

Ponderosa woodlands are not found at high elevations, but instead form a broad zone of coniferous forest along the southern flank of the San Juan Mountains, as well as along the eastern mountain front, generally at elevations between 6,000 and 9,000 ft. These habitats are in within the central portion of their North American distribution in Colorado. Annual precipitation is similar to that for oak shrubland, with a range of 18.9- 35.8 in (30-80 cm) and a mean of 20 in (51 cm). Ponderosa occurs in a broad middle range of growing season lengths across the state.

Although seeds are typically not dispersed very far, ponderosa pine is often present in mixed conifer stands; these areas may provide a seed bank for regeneration or a shift to ponderosa pine. Recruitment is episodic, depending on precipitation and disturbance patterns. These forests are susceptible to outbreaks of the mountain pine beetle (*Dendroctonus ponderosae*) and mistletoe infestations, both of which may be exacerbated by increased drought. Impacts of native grazers or domestic livestock could also alter understory structure and composition.

Ponderosa pine is well adapted to survive frequent surface fires, and mixed-severity fires are characteristic in these communities (Arno 2000). Although climate change may alter fire regimes

slightly by affecting the community structure, fire is not expected to have a severe impact in the future for these stands, and may actually be beneficial in some areas.

Adaptive Capacity Summary

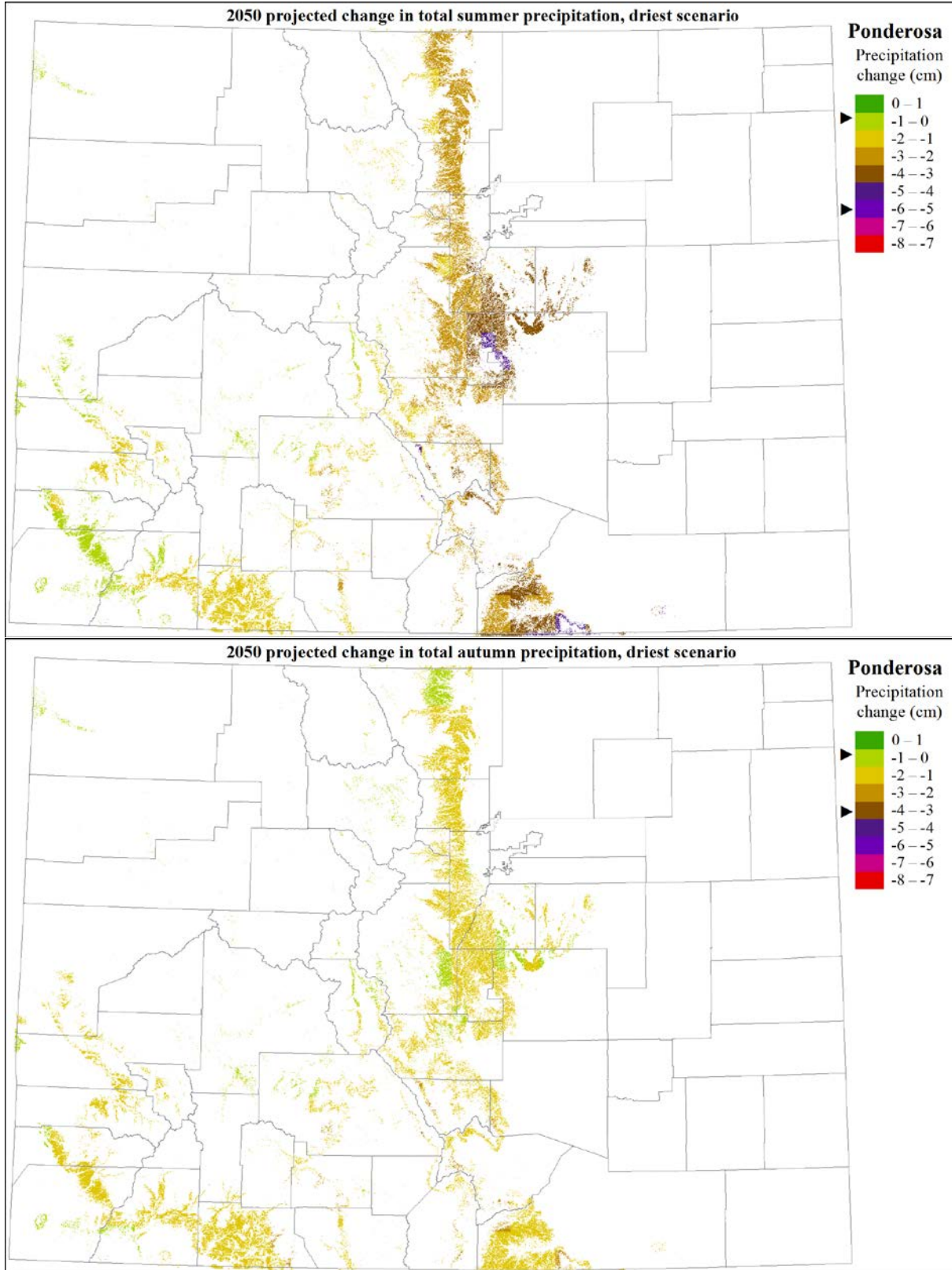
	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Ponderosa	0.87	0	0.67	0.67	0.54	0.53	M	Moderate

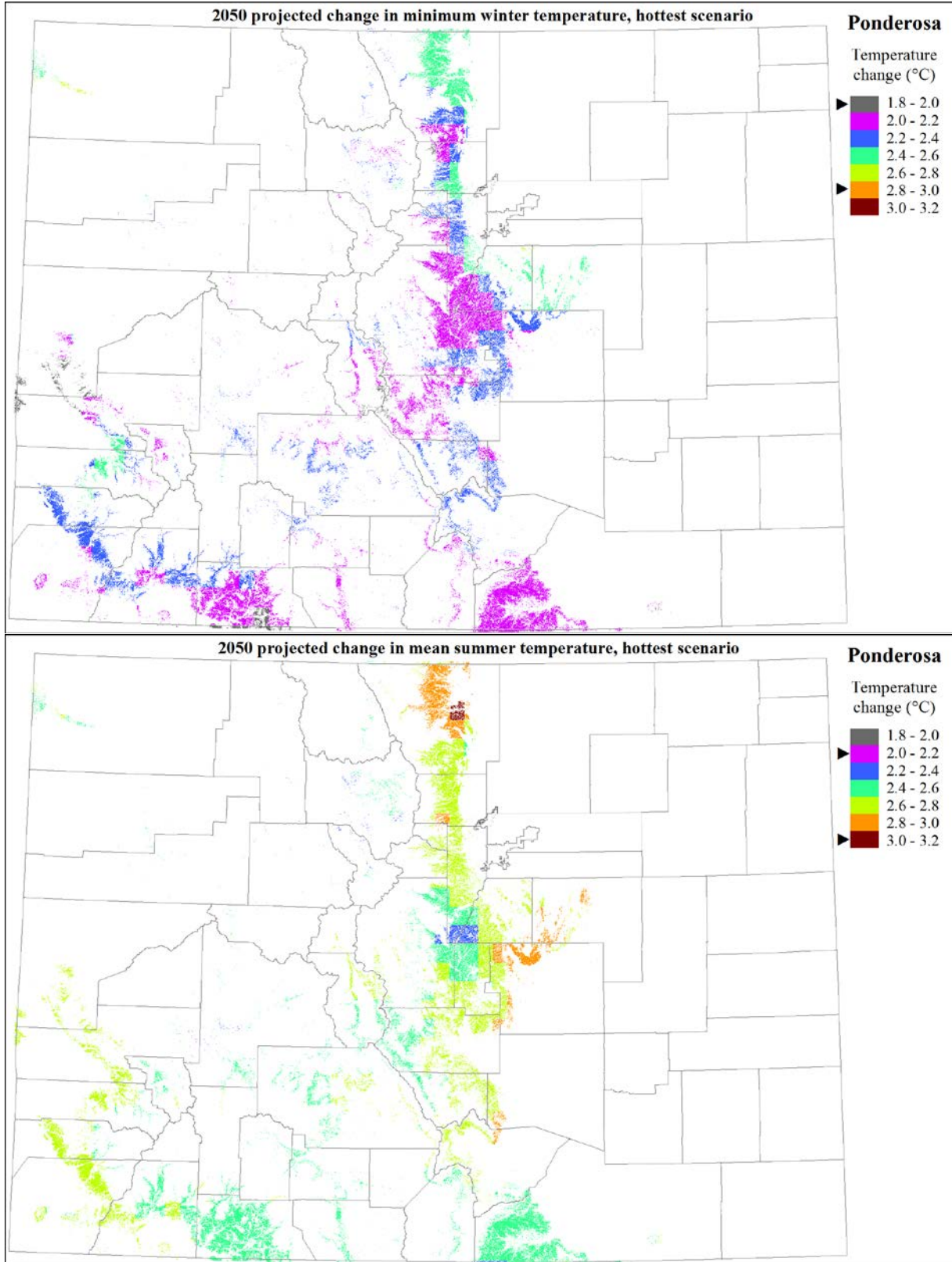
Vulnerability to Climate Change

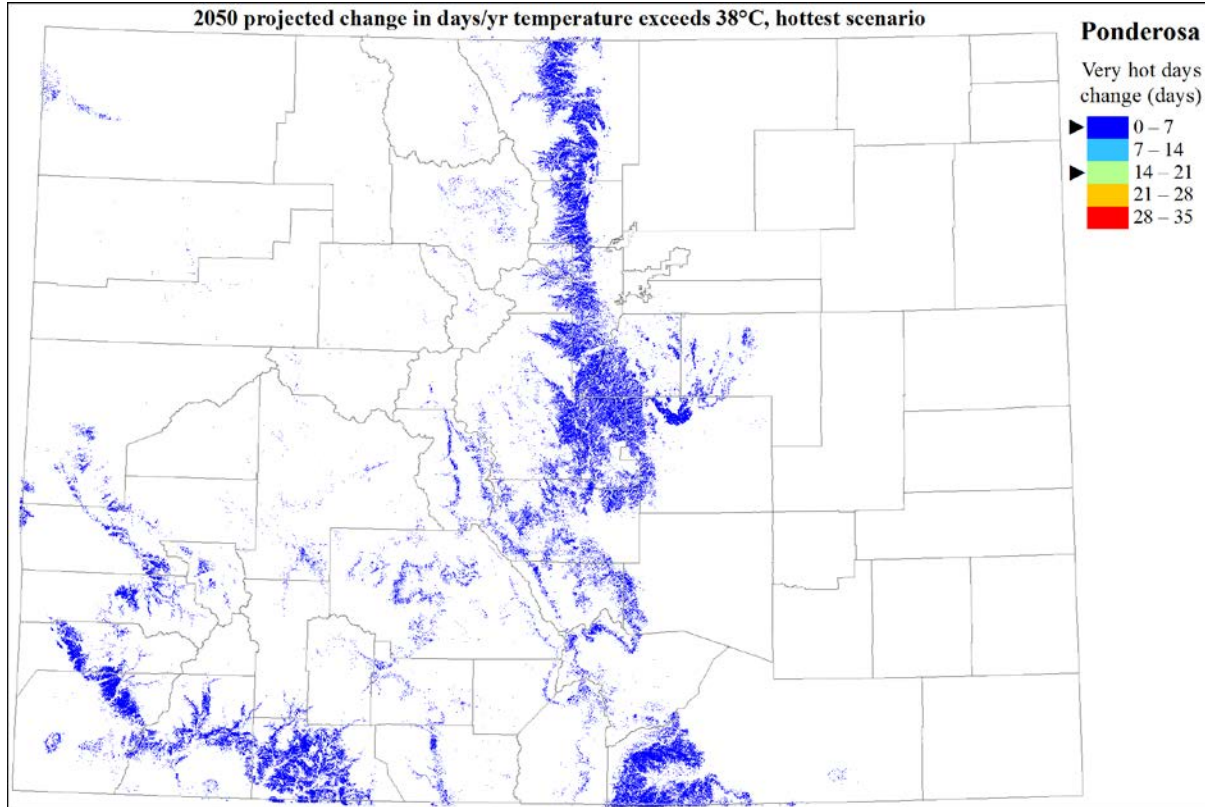
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Ponderosa pine forest & woodland	Moderate	Moderate	M/M	Moderate

Ponderosa pine forests and woodlands are ranked moderately vulnerable to the effects of climate change by mid-century under a moderate emissions scenario. Primary factors contributing to this ranking are the exposure of large areas of this habitat to warmer temperatures that are likely to interact with forest disturbances that are, in turn, exacerbated by warm, dry conditions.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for ponderosa habitats. Legend pointers indicate the range of change for this habitat within the statewide extent of change. Areas along the mountain front are projected to see the most decrease in summer and fall precipitation. The northern Front Range portion of the distribution is projected to experience the most warming. Very hot days (which may contribute to fire danger) may increase slightly throughout the distribution of ponderosa.







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SPRUCE-FIR

Climate Influences

Spruce-fir forest typically dominates the wettest and coolest habitats below treeline. These areas are characterized by long, cold winters, heavy snowpack, and short, cool summers where frost is common (Uchytel 1991). Both Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) are dependent on snowmelt water for most of the growing season, and in low snowpack years growth is reduced (Hu et al. 2010).

The length of the growing season is particularly important for both alpine and subalpine zones, and for the transition zone between alpine vegetation and closed forest (treeline). Treeline-controlling factors operate at different scales, ranging from the microsite to the continental (Holtmeier and Broll 2005). On a global or continental scale, there is general agreement that temperature is a primary determinant of treeline. Körner (2012) attributes the dominance of thermal factors at this scale to the relative consistency of atmospheric conditions over large areas, especially in comparison to more local influence of soil and moisture factors. Furthermore, there appears to be a critical duration of temperatures adequate for the growth of trees in particular (e.g., individuals >3m tall) that determines the location of treeline. At more local scales, soil properties, slope, aspect, topography, and their effect on moisture availability, in combination with disturbances such as avalanche, grazing, fire, pests, disease, and human impacts all contribute to the formation of treeline (Richardson and Friedland 2009, Körner 2012). Patterns of snow depth and duration, wind, insolation, vegetation cover, and the autecological tolerances of each tree species influence the establishment and survival of individuals within the treeline ecotone (Moir et al. 2003, Holtmeier and Broll 2005, Smith et al. 2009). In the Rocky Mountains, tree establishment was significantly correlated with warmer spring (Mar-May) and cool-season (Nov-Apr) minimum temperatures as well (Elliott 2012).

Spruce-fir forests currently occupy cold areas with high precipitation; warmer and drier climate conditions predicted by most models could result in an upward migration of these forests into the alpine zone. However, in Canadian spruce-fir forests, warmer than average summer temperatures led to a decrease in growth the following year (Hart and Laroque 2013). Since spruce-fir may be able to tolerate warmer summer temperatures, the lower extent of this habitat type could remain at current levels for some time, even if growth is reduced.

The current location of treeline is a result of the operation of climatic and site-specific influences over the past several hundred years, and does not exactly reflect the current climate (Körner 2012). The treeline position lag time behind climate change is estimated to be 50-100+ years, due

to the rarity of recruitment events, the slow growth and frequent setbacks for trees in the ecotone, and competition with already established alpine vegetation (Körner 2012). Nevertheless, on the basis of historic evidence, treeline is generally expected to migrate to higher elevations as temperatures warm, as permitted by local microsite conditions (Smith et al. 2003, Richardson and Friedland 2009, Grafius et al. 2012).

Furthermore, the lag time of decades or longer for treeline to respond to warming temperatures may allow the development of novel vegetation associations (Chapin and Starfield), and make it difficult to identify temperature constraints on the distribution of this habitat (Grafius et al. 2012). The gradual advance of treeline is also likely to depend on precipitation patterns. Seedling establishment and survival are greatly affected by the balance of snow accumulation and snowmelt. Soil moisture, largely provided by snowmelt, is crucial for seed germination and survival. Although snowpack insulates seedlings and shields small trees from wind desiccation, its persistence shortens the growing season and can reduce recruitment (Rochefort et al. 1994).

Exposure and Sensitivity Summary

Spruce-fir forests are projected to experience winter and summer temperatures warmer than the current range in a significant portion of their current distribution. Projected winter and spring precipitation levels are generally within the range of the current distribution.

Spruce-fir

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Winter precipitation (L)	2%
Spring precipitation (M, E)	5%
Mean winter minimum temperature (E)	31%
Mean summer temperature (M, E, L)	43%
Growing degree days - base 0 (L)	43%
Average range shift	23.3%
Rank	M
Exposure-Sensitivity level	Moderate

Resilience Components

Spruce-fir forests in Colorado have a wide elevational range, extending from about 8,900 ft. up to over 12,000 ft. Although not as restricted as alpine habitats, spruce-fir forests are generally

limited to higher, cooler elevations, and are also near the southern extent of their continental range in Colorado. Statewide, annual average precipitation is slightly lower than for alpine with a range of about 16-47 in. (40-120 cm) and a mean of 31 in. (80 cm). Spruce-fir requires a longer growing season than alpine habitat, but is successful at much cooler temperatures than most other forest types. Spruce-fir forests accumulate more annual growing degree days than alpine areas, but fewer than for other forested types.

Subalpine fir seeds require cold-moist conditions to trigger germination (Uchytel 1991), and there is some indication that Engelmann spruce seeds germinate faster at relatively low temperatures (Smith 1985), giving it a competitive advantage over less cold-tolerant species. Under warmer conditions, however, current spruce-fir communities may be gradually replaced by a mixed-conifer forest. There are no obvious barriers to the gradual dispersal of seedlings into adjacent, newly suitable habitat, although the dominant species are generally slow-growing.

Although these subalpine forests are not susceptible to increased prevalence of invasive species, they are vulnerable to outbreaks of the native pest species spruce bud worm and spruce beetle. Warmer temperatures (both winter and summer) are likely to facilitate these infestations; current distribution of spruce-fir habitat may therefore be at increased risk of significant mortality. Insect outbreaks are also typically associated with droughts.

Historic natural fire-return intervals in these forests have been on the order of several hundred years, and the tree species are not adapted to more frequent fires. With an increase in droughts and faster snowmelts, we might expect an increase in forest fire frequency and extent within this zone. It is not known if spruce-fir forests will be able to regenerate under such conditions, especially in lower elevation stands, and there is a potential for a reduction in spruce-fir forests, at least in the short term.

Adaptive Capacity Summary

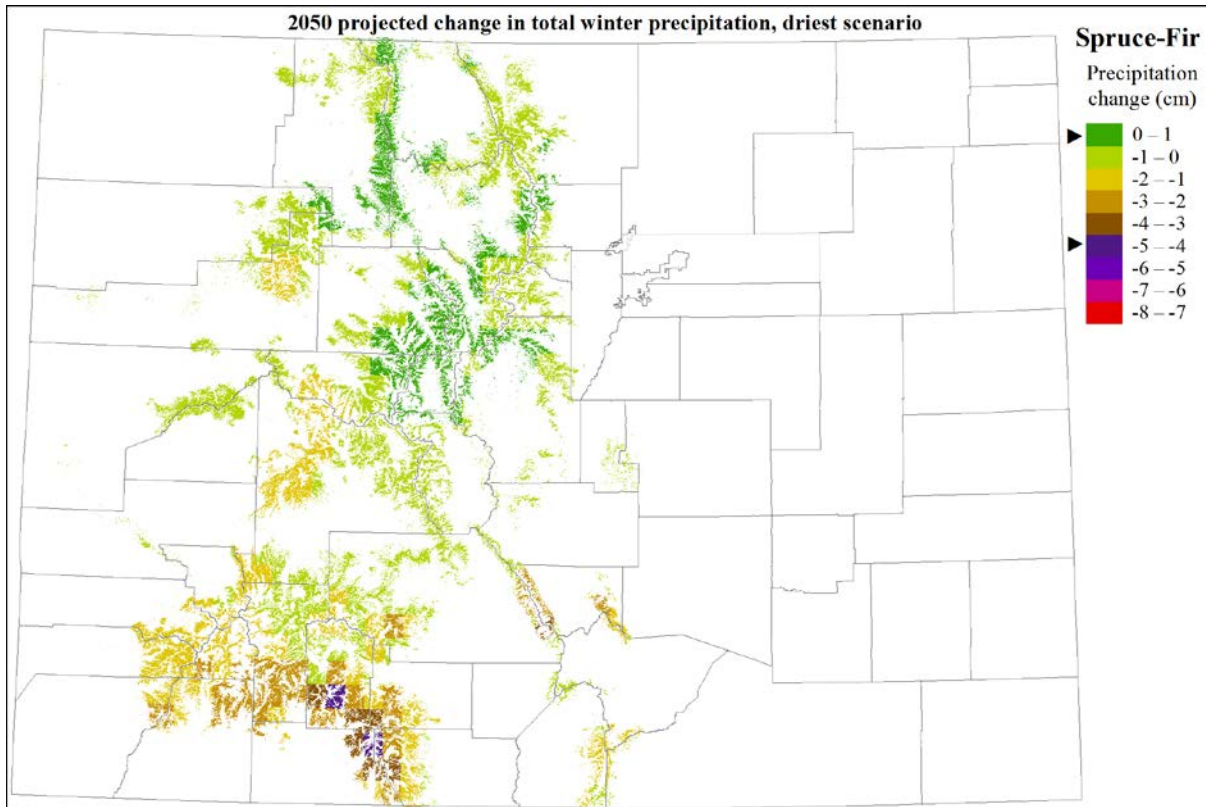
	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Spruce-fir	0.37	0	0.67	0.67	0.89	0.51	M	Moderate

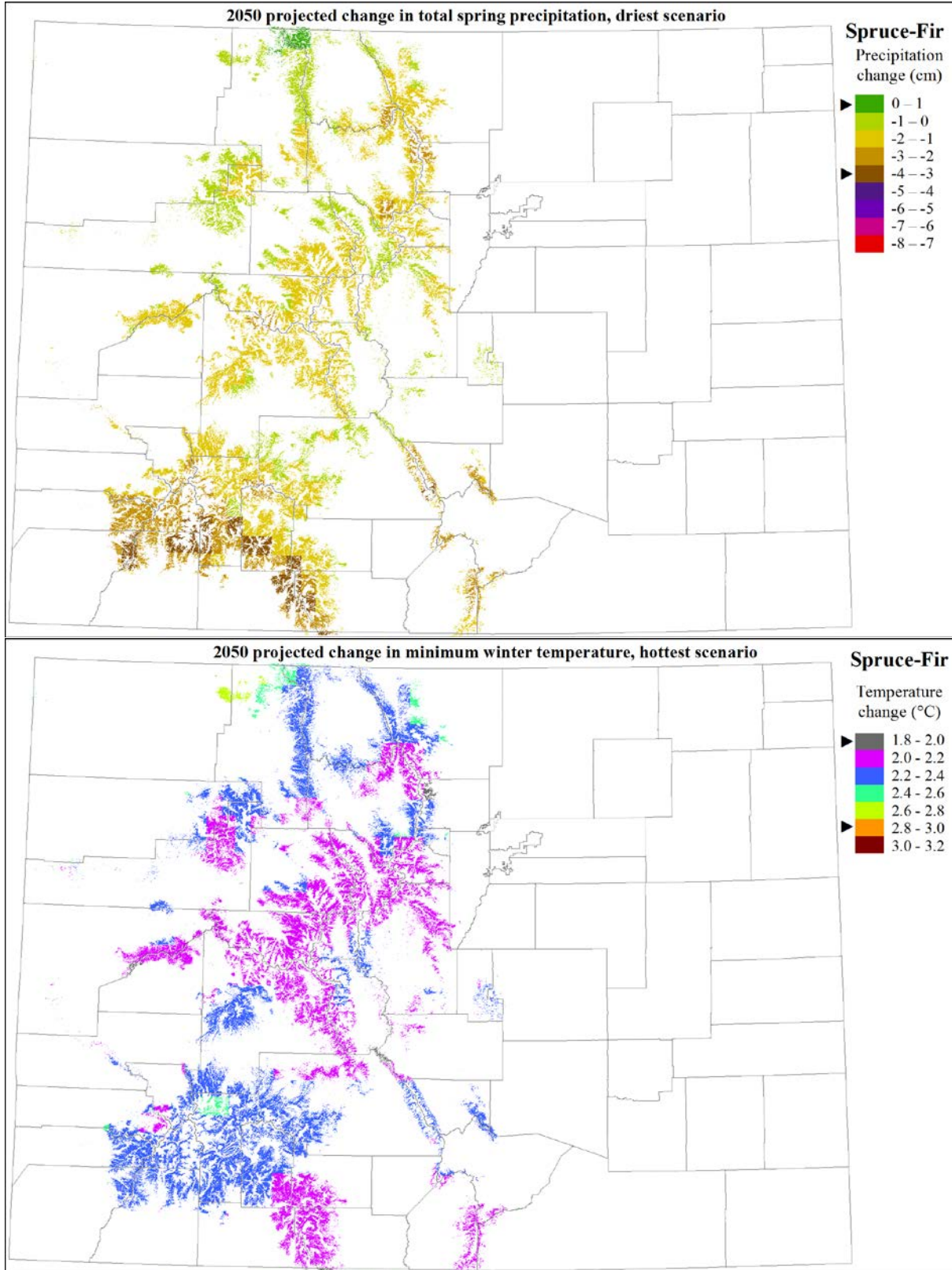
Vulnerability to Climate Change

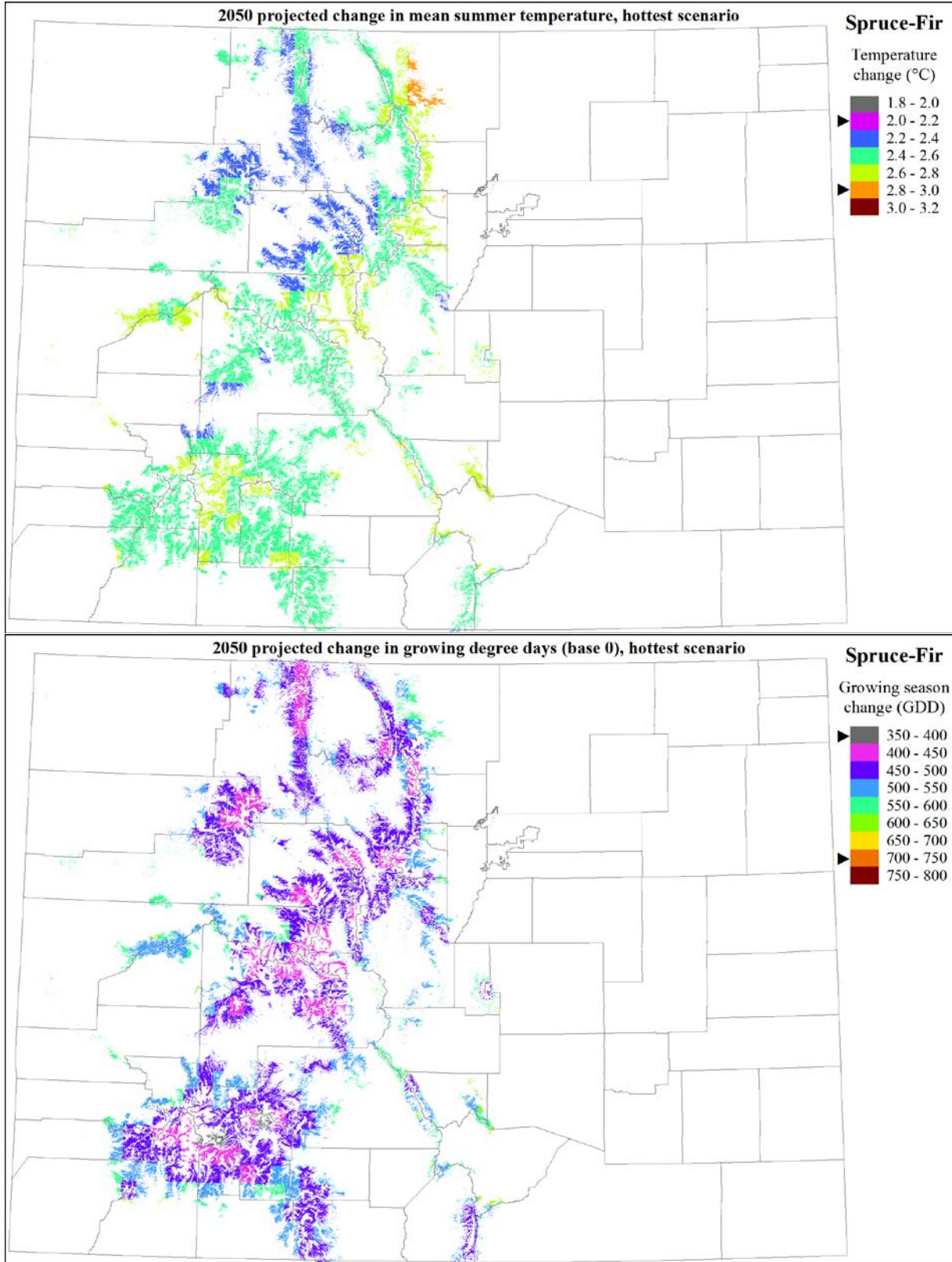
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Spruce-Fir forest	Moderate	Moderate	M/M	Moderate

Spruce-fir forests are ranked moderately vulnerable to the effects of climate change by mid-century under a moderate emissions scenario. Primary factors contributing to this ranking are the restriction of these habitats to higher elevations in Colorado, and the relatively narrow biophysical envelope. The majority of the North American distribution of Engelmann spruce and subalpine fir is to the north of Colorado. The slow growth and dispersal of these forests also contributes to their vulnerability.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for spruce-fir habitats. Legend pointers indicate the range of change for this habitat within the statewide extent of change. Areas on the southern flank of the San Juan Mountains are projected to experience the greatest reductions in winter and spring precipitation under a dry scenario, while northern portions of the range are little changed. Winter minimum temperatures are projected to warm by at least 2°C throughout the range, and summer mean temperatures may increase even more, especially in northern Colorado. Overall, the growing season for spruce-fir forests in the state is expected to increase, which could eventually facilitate the migration of this habitat to higher elevations.







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OAK-MIXED MOUNTAIN SHRUB

Climate Influences

In general, the upper and lower elevational limits of Gambel oak (*Quercus gambelii*) shrubland are believed to be controlled by temperature and moisture stress. Neilson and Wullstein (1983) found that seedling mortality was primarily due to spring freezing, grazing, or summer drought stress. At more northern latitudes, the zone of tolerable cold stress is found at lower elevations, but, at the same time, the areas where summer moisture stress is tolerable are at higher elevations. Neilson and Wullstein (1983) hypothesize that the northern distributional limit of Gambel oak corresponds to the point where these two opposing factors converge. Oak shrublands are typically found in areas with mean annual temperatures between 7 and 10°C (12.6-18.0°F; Harper et al. 1985). At higher, cooler elevations, acorn production may be limited by the shortness of the growing season, and most reproduction is likely to be vegetative (Christensen 1949). Warming temperatures may increase both acorn production and seedling survival.

Oaks are most likely to do well under warmer temperatures, although droughts and late frosts may affect the frequency of establishment through seedling recruitment by reducing the acorn crop in some years.

Exposure and Sensitivity Summary

Oak and mixed mountain shrublands are projected to experience temperatures warmer than the current range in more than one third of the current distribution, as well as a shift to earlier date of last spring frost in some areas. Projected spring and summer precipitation levels are projected to be lower than the driest end of the current range for a small part of the current distribution.

Oak

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Spring precipitation (M, E)	8%
Summer precipitation (M, E, L)	13%
Drought days (M, L)	6%
Date of last frost in spring (M, E, L)	-8%
Mean annual temperature (L)	38%
Average range shift	13.4%
Rank	L
Exposure-Sensitivity level	Low

Resilience Components

Oak and mixed mountain shrublands are widespread in the western half of Colorado, and along the southern stretch of the mountain front at elevations from about 6,000- 9,000 feet. The elevation range of this habitat is similar to that of ponderosa pine, and these habitats are often adjacent. Stands dominated by Gambel oak are common in the southern part of Colorado, but are completely interspersed with stands dominated by other shrub species, especially serviceberry (*Amelanchier* spp.) with mahogany (*Cercocarpus* spp.) at higher elevations. These habitats are not limited to higher elevations, and are not at the southern extent of their North American distribution in Colorado. Average annual precipitation for oak shrubland is about 12-32 in (30-80 cm), with a mean of 21.5 in (52 cm). Precipitation amounts for mixed mountain shrubland are probably slightly higher. Growing season is similar to that of ponderosa and higher elevation sagebrush.

Gambel oak reproduces primarily by sprouting of new stems, especially after disturbances such as logging, fire, and grazing, although recruitment from seedlings does occur (Brown 1958, Harper et al. 1985). The extensive clonal root system of Gambel oak is a primary contributor to its ability to survive during periods when seedling establishment is impossible. Historic natural fire return intervals were on the order of 100 years in Mesa Verde (Floyd et al. 2000); under such conditions of low fire frequency, vulnerable newly sprouted stems are able to persist and form dense thickets.

Non-oak dominated montane shrublands are of variable species composition, depending on site conditions such as elevation, slope, aspect, soil type, moisture availability, and past history. Species present may include mountain mahogany (*Cercocarpus montanus*), skunkbush sumac

(*Rhus trilobata*), cliff fendlerbush (*Fendlera rupicola*), antelope bitterbrush (*Purshia tridentata*), wild crab apple (*Peraphyllum ramosissimum*), snowberry (*Symphoricarpos* spp.), and serviceberry (*Amelanchier* spp.). Most of these species reproduce both vegetatively and by seedling recruitment, as well as re-sprouting easily after fire. Variable disturbance patterns may account for the local dominance of a particular species (Keeley 2000). Although fire is an obvious source of disturbance in these shrublands, snowpack movements (creep, glide, and slippage) may also provide significant disturbance in slide-prone areas (Jamieson et al. 1996).

In some areas, oak stands are vulnerable to increased prevalence of invasive species such as cheatgrass and knapweeds. Currently there are few invasives in the stands dominated by serviceberry and mahogany. These shrublands are highly fire tolerant. It is possible for this system to move up in elevation, especially if fires open up some of the adjacent forested ecosystems.

Adaptive Capacity Summary

	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Oak	0.89	1	1	1	0.49	0.85	H	High

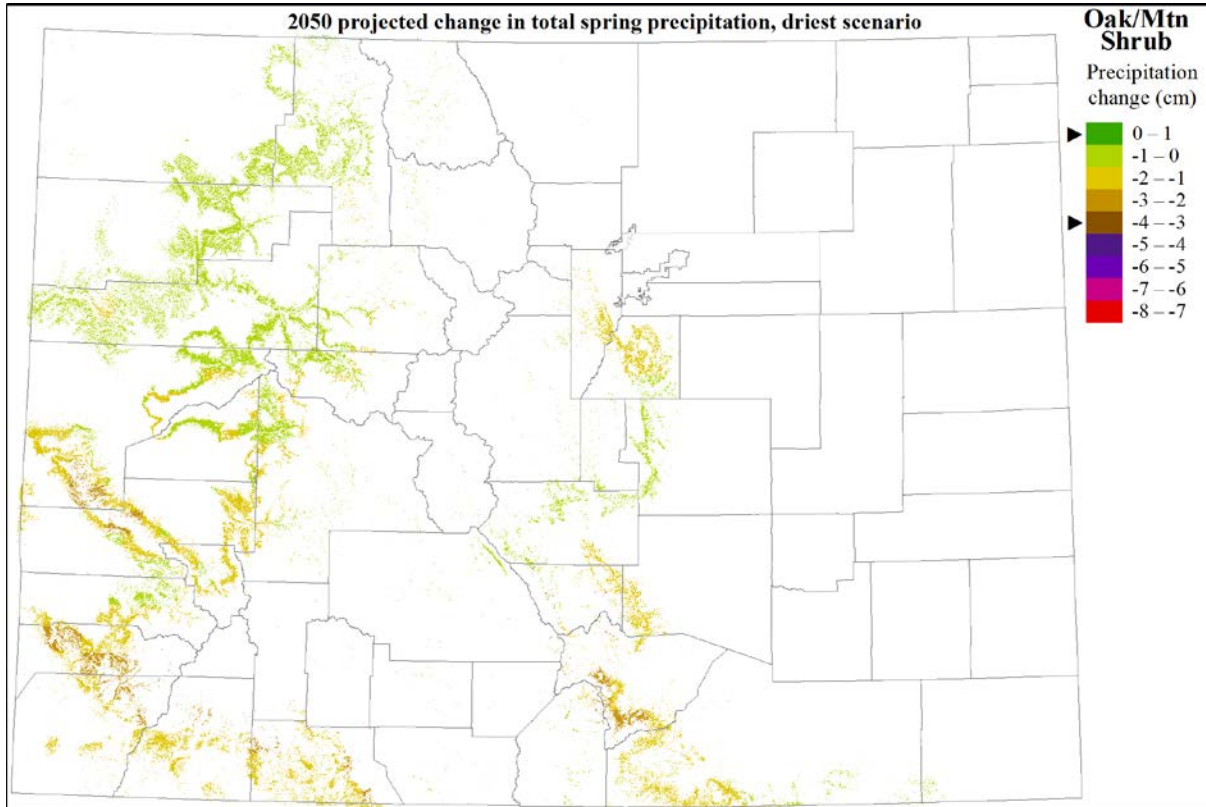
Vulnerability to Climate Change

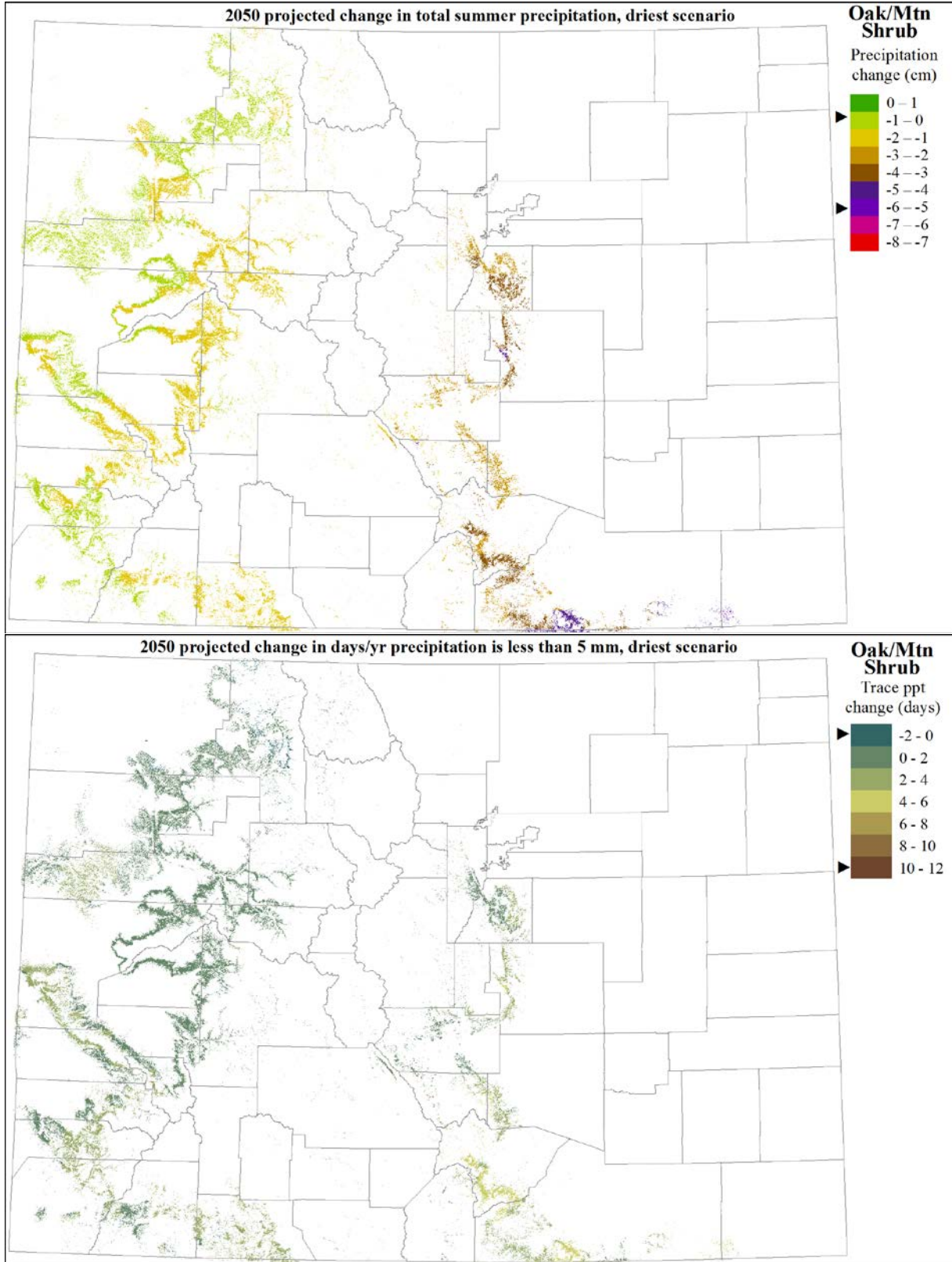
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Oak & mixed mountain shrub	Low	High	L/H	Low

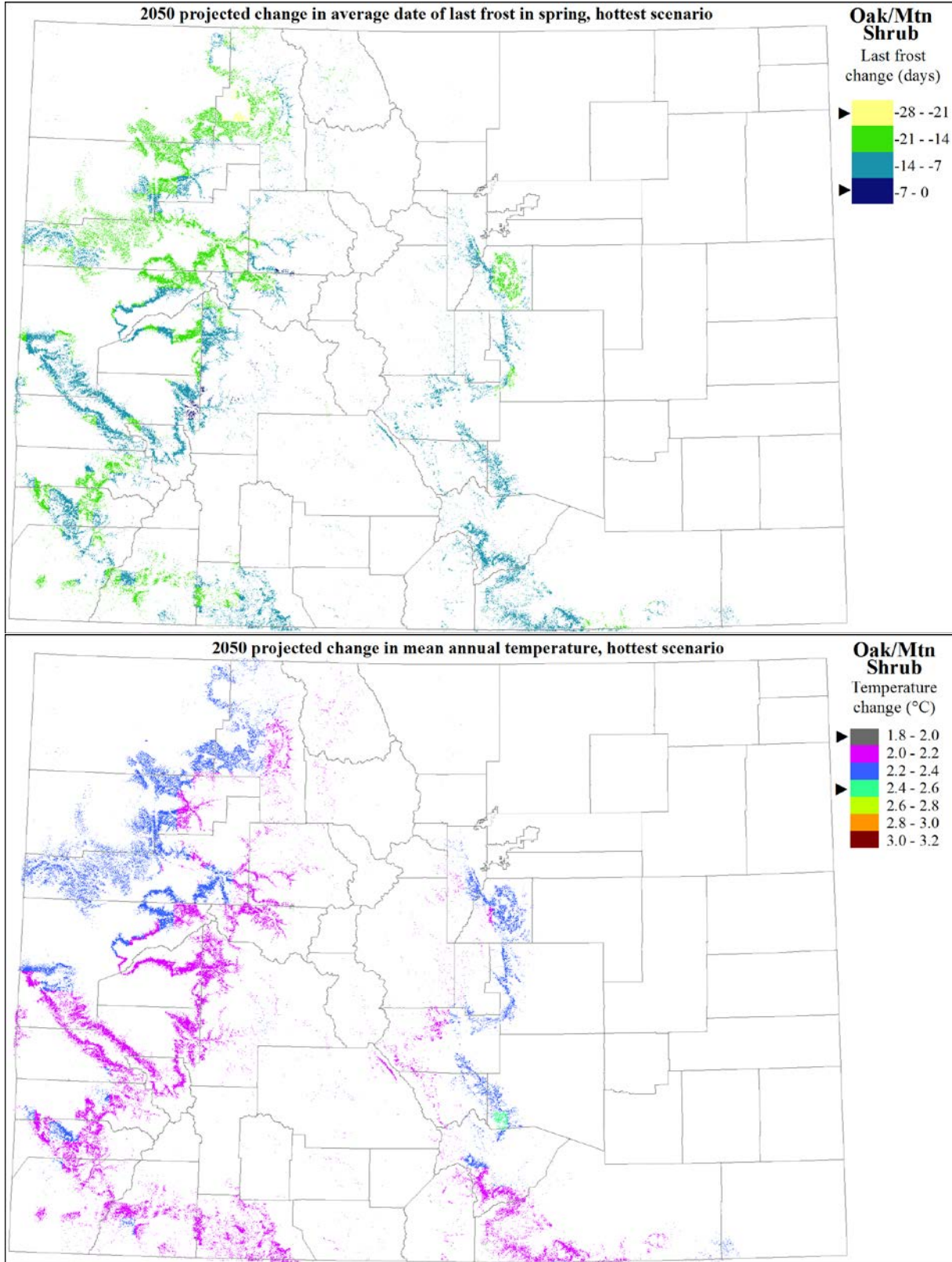
Oak and mixed mountain shrublands are ranked as having low vulnerability to the effects of climate change by mid-century under a moderate emissions scenario. Primary factors contributing to this ranking are the wide ecological amplitude of these shrublands in Colorado, and their ability to withstand or recover from disturbance relatively quickly, which offsets the lower landscape condition score due to past anthropogenic disturbance levels.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for oak and mixed mountain shrub habitats. Legend pointers indicate the range of change for this habitat within the statewide extent of change. Precipitation during the growing season is projected to decrease most in the southern and eastern portions of the distribution of this habitat within Colorado, although it is likely to remain well within the

tolerance of these shrublands. The projected shift to 1-2 weeks earlier last frosts in spring would be beneficial for this habitat, and although annual mean temperatures are projected to increase by at least 2°C in the hottest scenario, this is also likely to remain within the tolerance of most occurrences.







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SAGEBRUSH

Climate Influences

As evaluated herein, the three subspecies of big sagebrush (basin big sagebrush, *Artemisia tridentata* ssp. *tridentata*, mountain big sagebrush, *A. tridentata* ssp. *vaseyana*, and Wyoming big sagebrush, *A. tridentata* ssp. *wyomingensis*) are combined as sagebrush habitat. In general, Wyoming big sagebrush is found in drier, warmer areas where precipitation is more likely to be in the form of rain, while mountain big sagebrush is found at higher, cooler elevations where snow is the dominant form of precipitation (Howard 1999, Johnson 2000). Changes in temperature and precipitation patterns may result in shifts in the relative abundance and distribution of the three subspecies.

Bradley (2010) points out that sagebrush shrublands in the western U.S. are currently found across a wide latitudinal gradient (from about 35 to 48 degrees north latitude), which suggests adaptation to a correspondingly wide range of temperature conditions. However, because these shrublands are apparently able to dominate a zone of precipitation between drier saltbush shrublands and higher, somewhat more mesic pinyon-juniper woodland, the distribution of sagebrush shrublands is likely to be affected by changes in precipitation patterns (Bradley 2010).

Seasonal timing of precipitation is important for sagebrush habitats; summer moisture stress may be limiting if winter precipitation is low (Germino and Reinhardt 2014). Seedlings of mountain big sagebrush were more sensitive to freezing under reduced soil moisture conditions (Lambrecht et al. 2007).

Under experimental warming conditions in a high-elevation population, mountain big sagebrush had increased growth, suggesting that longer growing season length could facilitate the expansion of sagebrush habitat into areas that were formerly too cold for the shrub (Perfors et al. 2003). However, Poore et al. (2009) found that high summer temperatures resulted in lower growth rate, due to increased water stress. Winter snowpack was critical for sagebrush growth; lower elevations are probably at more risk from temperature impacts in comparison to upper elevations due to less snow and, consequently greater water stress.

Schlaepfer et al. (2012) modeled future distribution of the big sagebrush ecosystem in the western U.S. Over the entire study area, sagebrush distribution was predicted to decrease, especially under higher CO₂ emissions scenarios. The strongest decreases are in the southern part of the range, while the distribution is predicted to increase at higher elevations and in more northern areas.

Exposure and Sensitivity Summary

Sagebrush shrublands are projected to experience an increase in number of very hot days in comparison with the current range in more than one quarter of the current distribution, and fall frost dates are likely to be later for some areas as well. Projected winter precipitation levels are generally within the current range, but spring and summer precipitation for 6-12% of the current distribution are projected to be lower than the driest end of the current range.

Sagebrush

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Winter precipitation (L)	0%
Spring precipitation (E, L)	6%
Summer precipitation (M, E, L)	12%
Date of first frost in fall (E)	13%
Very hot days (M)	27%
Average range shift	11.7%
Rank	L
Exposure-Sensitivity level	Low

Resilience Components

These shrublands are primarily found in the western part of the state, at elevations from about 5,000 to 9,500 ft. The North American distribution of sagebrush habitat is largely to the west and north of Colorado. The three subspecies of big sagebrush show an elevational separation, with mountain big sagebrush in wetter, cooler conditions of higher elevations, and Wyoming big sagebrush in the warmest and driest conditions at lower elevations (Howard 1999). Due to the adaptations of the various subspecies, the range of annual average precipitation for sagebrush habitats is fairly wide, from about 8-40 in (20-100 cm), with a mean of 18 in (45 cm). Growing season heat accumulation is also highly variable across the range of the habitat, for the same reason.

Because these are generally shrublands of lower elevations, they are not expected to be limited by a requirement for cooler, high elevation habitat. Although sagebrush is generally a poor seeder, with small dispersal distances, there are no apparent barriers to dispersal for these shrublands. These stands may also be somewhat vulnerable to changes in phenology.

Other stressors for sagebrush shrublands are invasion by cheatgrass and expansion of pinyon-juniper woodlands. There is a moderate potential for invasion by knapweed species, oxeye daisy, leafy spurge, and yellow toadflax under changing climatic conditions, and a potential for changing fire dynamics to affect the ecosystem. There is no information on the vulnerability of this ecosystem to insect or disease outbreak.

Although sagebrush tolerates dry conditions and fairly cool temperatures it is not fire adapted, and none of the subspecies resprout after fire (Tirmenstein 1999). Sagebrush shrubland is likely to be severely impacted by intense fires that enhance wind erosion and eliminate the seed bank (Young and Evans 1989). Increased drought may increase fire frequency and severity, eliminating sagebrush in some areas, especially at drier sites of lower elevations. Increased fire frequency and severity in these shrublands may result in their conversion to grasslands dominated by exotic species.

Adaptive Capacity Summary

	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Sagebrush	0.93	0.5	0.67	0.33	0.53	0.57	M	Moderate

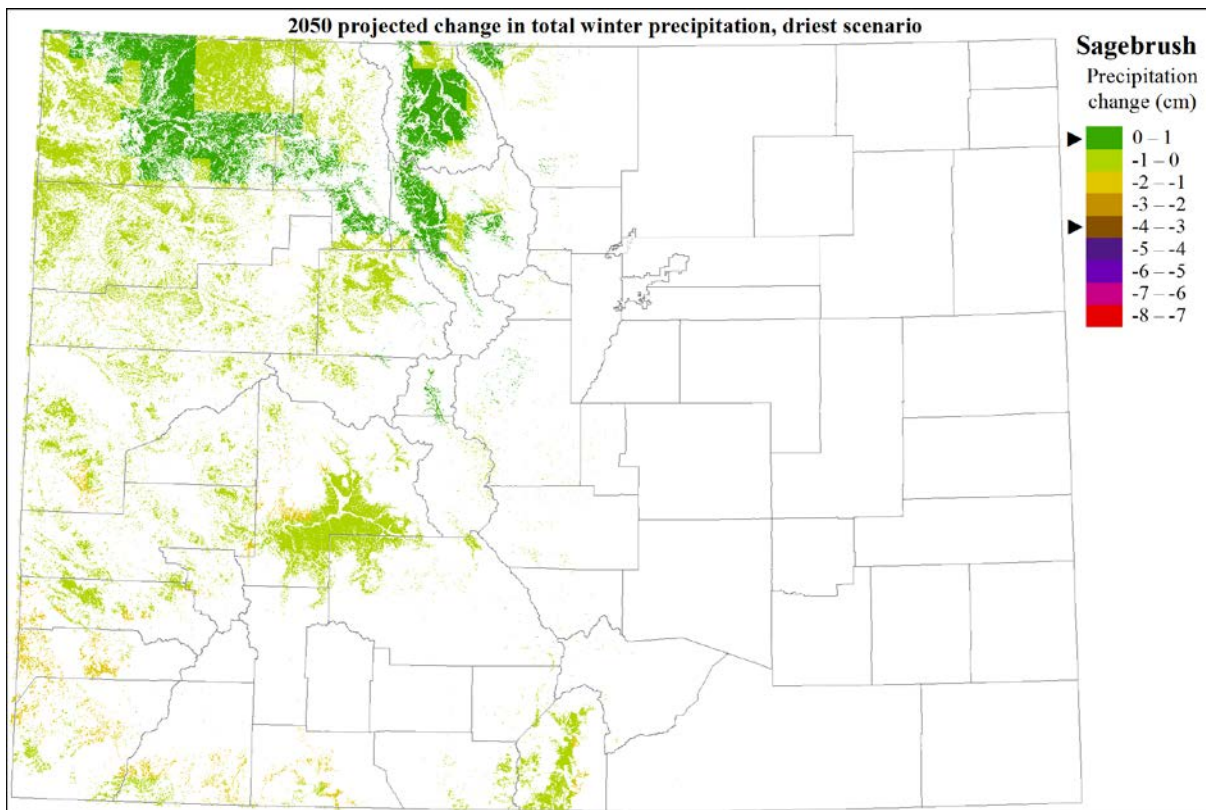
Vulnerability to Climate Change

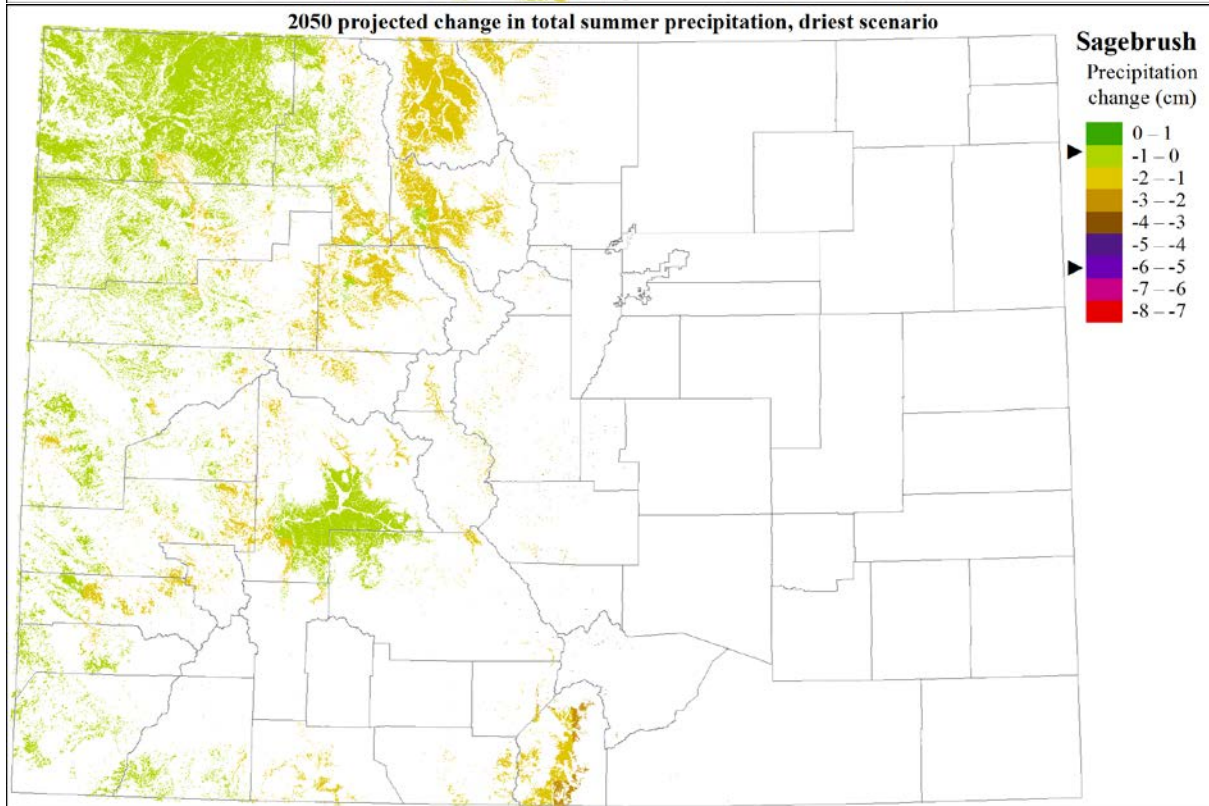
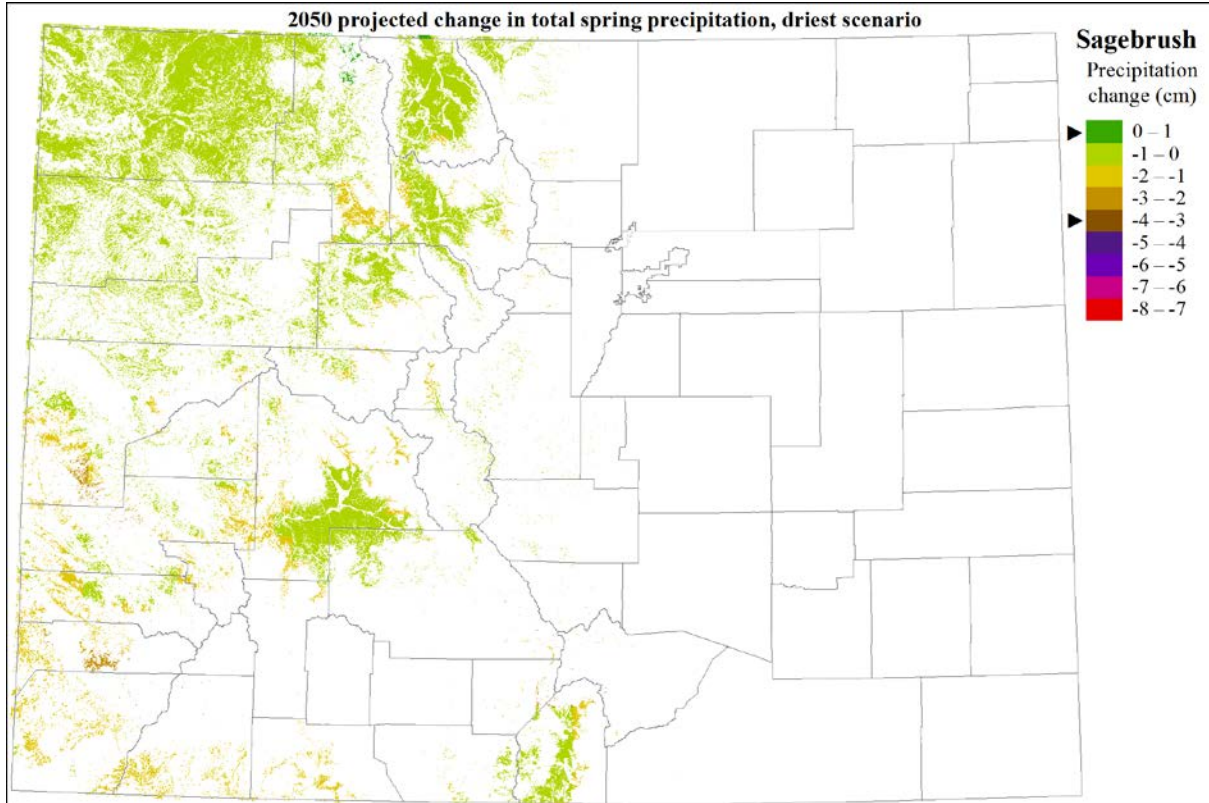
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Sagebrush shrubland	Low	Moderate	L/M	Low

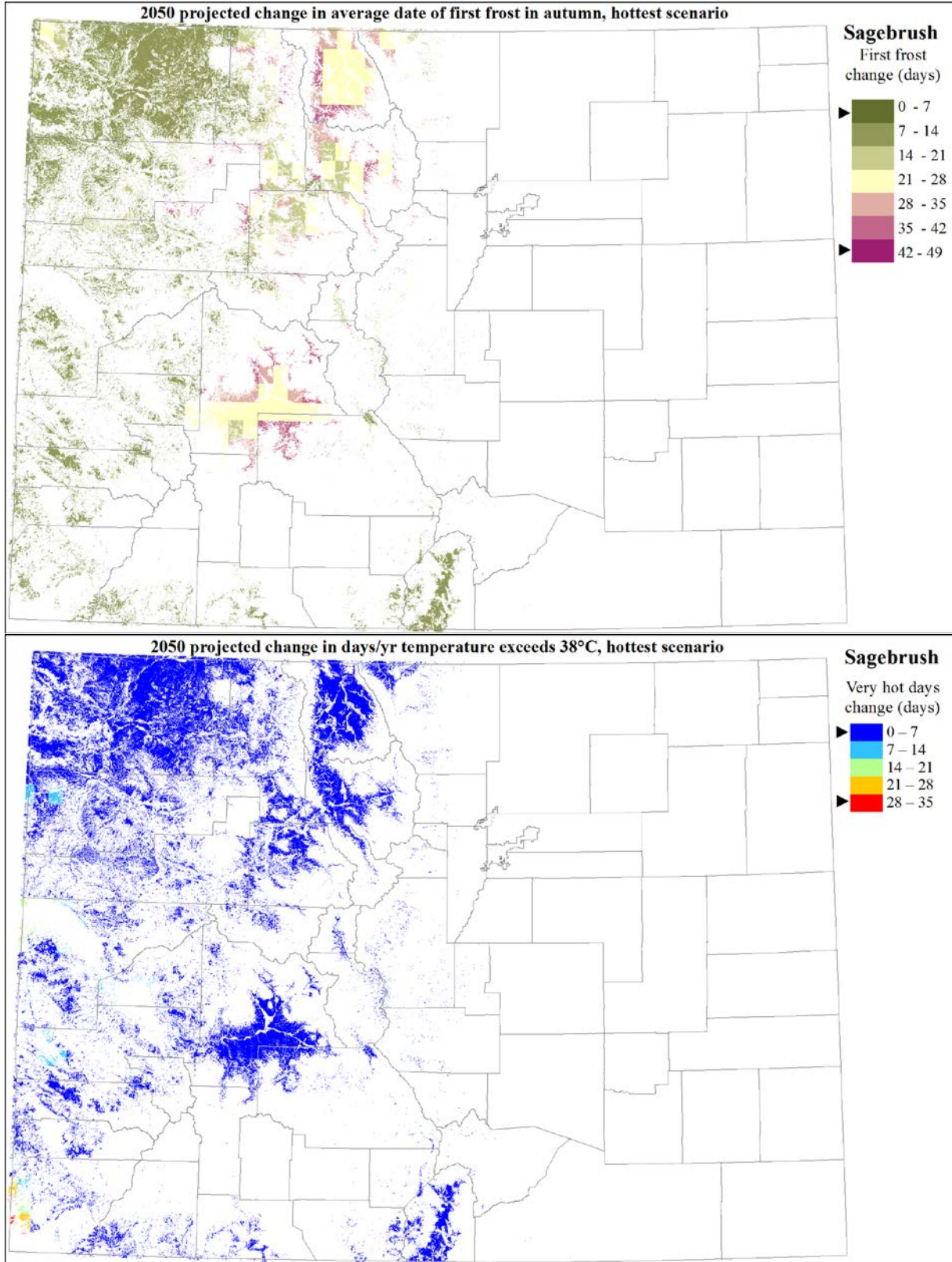
Sagebrush shrublands are ranked as having low vulnerability to the effects of climate change by mid-century under a moderate emissions scenario. The primary factor contributing to this ranking is the projected low exposure to warmer and drier future conditions in the part of Colorado where the greater portion of this habitat is found. The combination of the three big sagebrush subspecies in our analysis collectively gives this habitat type a wide ecological amplitude. Under a more severe emissions scenario, these shrublands would have higher vulnerability, similar to the assessment of Pocerwicz et al. (2014) for sagebrush habitats in Wyoming.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for sagebrush habitats. Legend pointers indicate the range of change

for this habitat within the statewide extent of change. Winter and spring precipitation levels are projected to decrease the most in the southwestern part of the Colorado distribution of sagebrush, while the majority of these shrublands in northwestern Colorado may see little change. Summer precipitation shows the greatest projected decrease in the eastern parts of the habitat distribution, especially in the high intermountain valleys. In portions of the distribution from the Gunnison valley up to North Park, average dates of first fall frost could be shifted 1-4 weeks later than current means. With the exception of the extreme southwest corner of Colorado, sagebrush shrublands in the state may experience only a slight increase in the number of very hot days. These trends tend to indicate that lower elevation sagebrush stands in the southern part of Colorado are most vulnerable.







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SANDSAGE

Climate Influences

This habitat has often been treated as an edaphic variant of eastern plains mixed-grass prairie (Albertson & Weaver 1944, Daley 1972), or of shortgrass prairie (Ramaley 1939, Sims and Risser 2000). Sand sage (*Artemisia filifolia*) forms extensive open shrublands in sandy soils of Colorado's eastern plains, and is of particular importance for both greater and lesser prairie chicken habitat, as well as for other grassland birds. In eastern Colorado, this system is found in extensive tracts on Quaternary eolian deposits along the South Platte, Arikaree and Republican Rivers, between Big Sandy and Rush Creeks, and along the Arkansas and Cimarron Rivers, where it is contiguous with areas in Kansas and Oklahoma (Comer et al. 2003). During the past 10,000 years, these areas are likely to have fluctuated between active dune fields and stabilized, vegetated dunes, depending on climate and disturbance patterns (Forman et al. 2001). Extended periods of severe drought or other disturbance that results in loss of stabilizing vegetation can quickly lead to soil movement and blowouts that inhibit vegetation re-establishment, and may eventually lead to dramatically different species composition.

Little is known about the tolerance of sand sage for soils other than well-drained sand with a low silt and clay component. Such soils are often "droughty", with reduced water-holding ability, and consequently, the potential for increased water stress to resident plants (Soil Survey Division Staff 1993). Rasmussen and Brotherson (1984) speculated that sand sage is adapted to less fertile soils than species of adjacent grassland communities. Ramaley (1939) indicated that the persistence of sand sage was facilitated by fire and long overgrazing, in the absence of which a site would transition to sand prairie. However, there is no evidence to suggest that, under certain combinations of temperature, precipitation, grazing, and other disturbance, sand sage would be unable to expand onto other soil types.

Sand sage occurrences in southern Colorado have historically experienced a long growing season, low annual precipitation, and seasonal differences in precipitation patterns from north to south (Western Regional Climate Center 2004). North-south gradients in temperature and precipitation on Colorado's eastern plains appear to be reflected in the species composition of sand sage habitat, especially in midgrass species (Daley 1972), which may contribute to variable vulnerability between northern and southern stands.

This habitat is well adapted to sandy soils, and may be able to expand into adjacent areas under warmer, drier conditions, depending on disturbance interactions. Overall condition and composition of these shrublands may change with changing climate.

Exposure and Sensitivity Summary

Sandsage shrublands are projected to experience temperatures warmer than the current range in most of the current distribution, including an increase in number of very hot days. Projected winter and spring precipitation levels are projected to be lower than the driest end of the current range for 15-19% of the distribution, and drought days are projected to increase in additional areas.

Sandsage

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Winter precipitation (M, E)	19%
Spring precipitation (E)	15%
Drought days (M)	29%
Growing degree days - base 0 (L)	84%
Very hot days (L)	87%
Average range shift	46.7%
Rank	H
Exposure-Sensitivity level	High

Resilience Components

Sandsage habitat dominates sandy soils of Colorado's eastern plains, at elevations generally below 5,500 ft. In other states, sand sage is known to occur up to 6,000 ft. (McWilliams 2003). Sandsage shares the dry and warm climate of shortgrass. Annual average precipitation is on the order of 10-18 inches (25-47 cm), with a mean of 16 in (40 cm). The growing season is generally long, with frequent high temperatures.

Sagebrush species in general have poor dispersal ability, with most seeds landing close to the parent plant (McWilliams 2003). Although sand sage does not reproduce vegetatively, it is able to resprout after fire. Fire extent and intensity are correlated with climate and grazing effects on fuel loads. Fire and grazing are both important disturbance processes for sand sage habitat, and may interact with drought, as well as permitting invasive exotic plant species to establish and spread. A significant portion of this habitat has been converted from midgrass to shortgrass sand sage community, in large part due to long-term continuous grazing by domestic livestock (LANDFIRE 2006).

Adaptive Capacity Summary

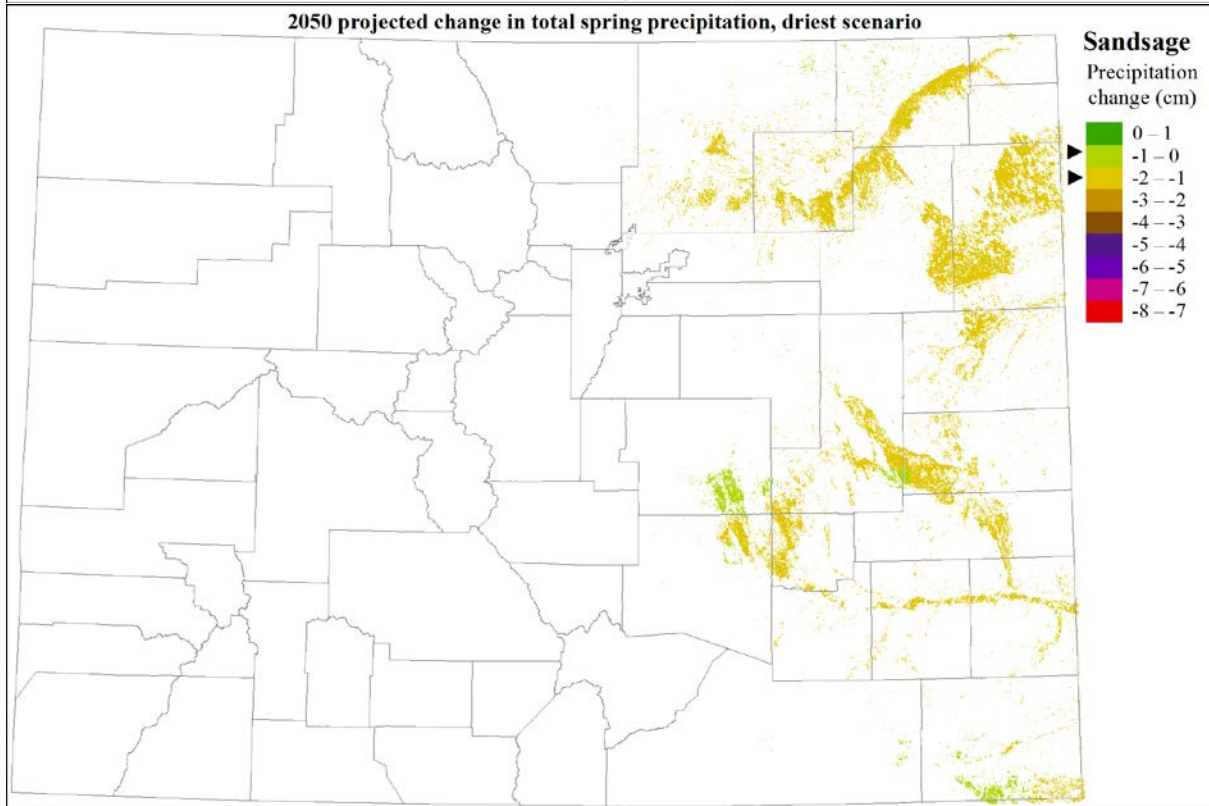
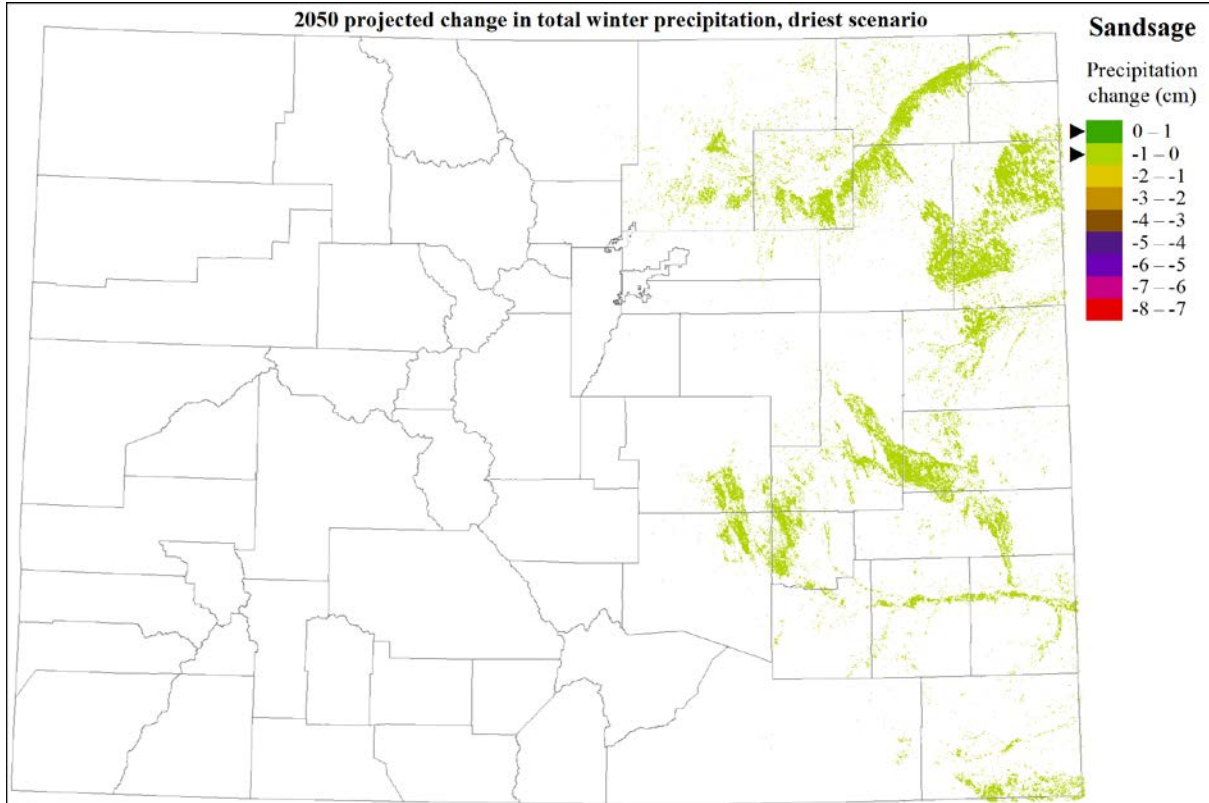
	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Sandsage	0.65	1	0.67	1	0.43	0.74	H	High

Vulnerability to Climate Change

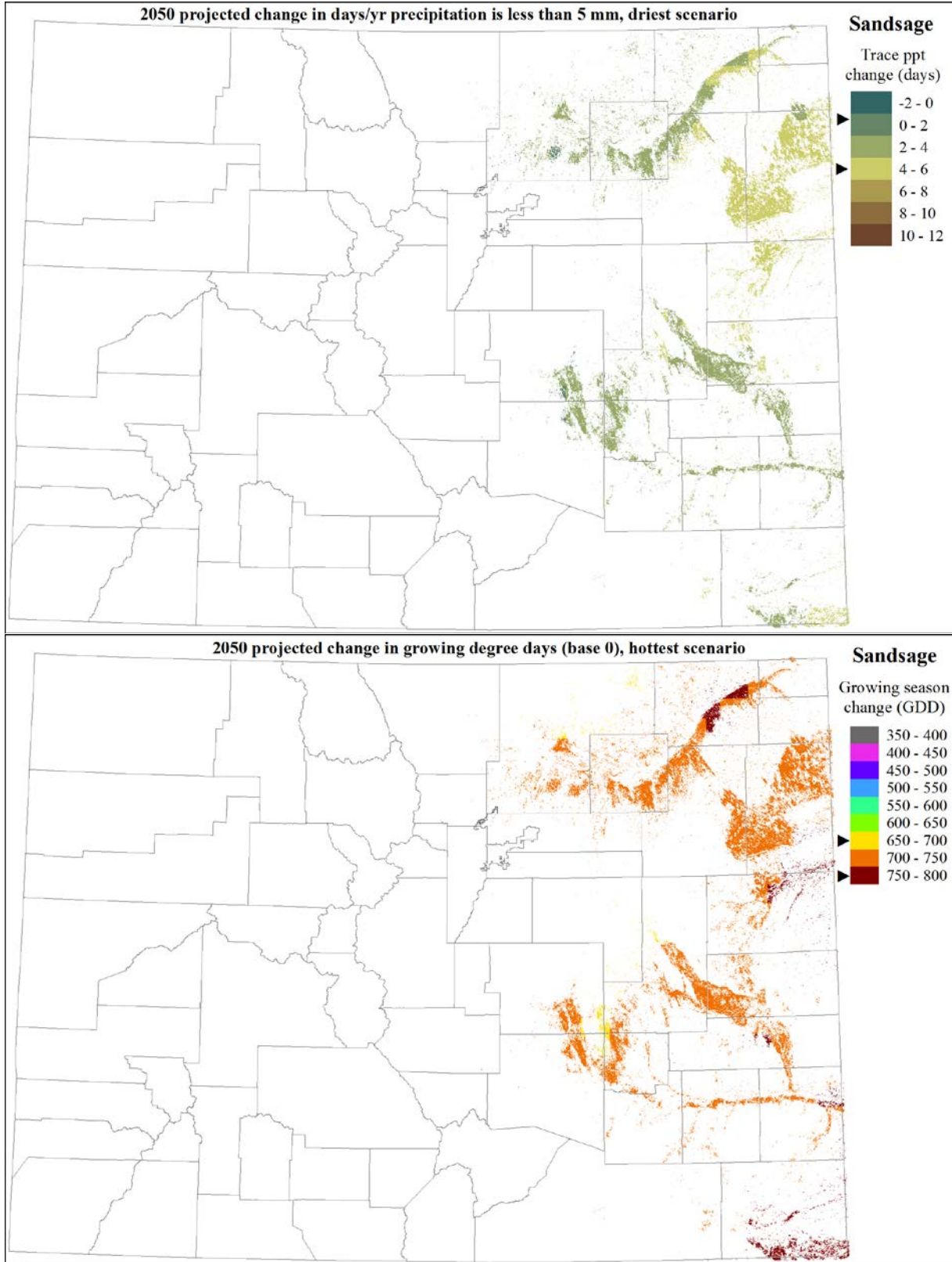
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Sandsage shrubland	High	High	H/H	Moderate

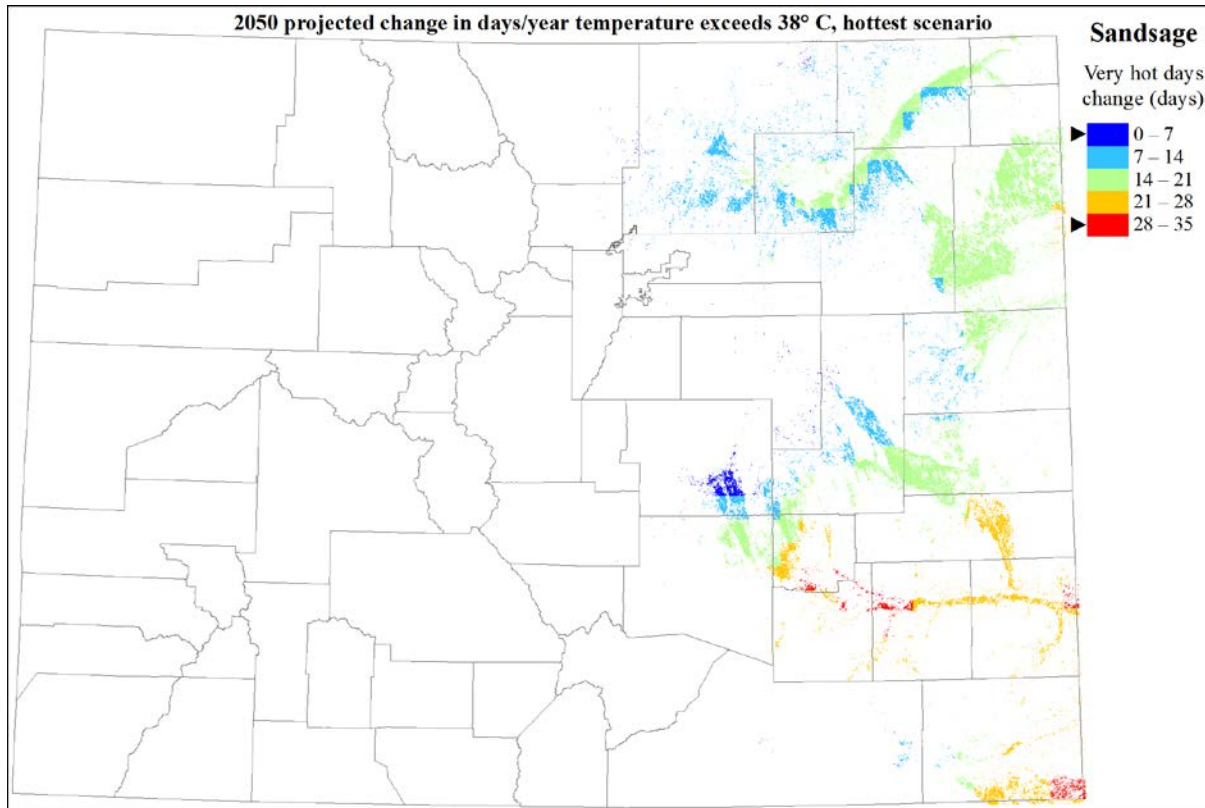
Sandsage shrublands are ranked moderately vulnerable to the effects of climate change by mid-century under a moderate emissions scenario. This ranking is primarily due to the concentration of greatest exposure for all temperature variables on the eastern plains of Colorado, where these habitats are found. In addition, anthropogenic disturbance in these shrublands has reduced the overall landscape condition of the habitat.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for sandsage habitats. Legend pointers indicate the range of change for this habitat within the statewide extent of change. Under the driest future projections, decrease in winter precipitation is generally less than 1 cm, within the range of these shrublands in Colorado, while the decrease in spring precipitation is greater, at 1-2 cm. Eastern sandsage stands may experience several fewer days of measurable precipitation per year. The greatest projected change for sandsage shrublands in Colorado is in very hot days and growing season length, both of which show a substantial increase, especially in the southeastern part of the state.



Colorado's 2015 State Wildlife Action Plan





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FOOTHILL AND MOUNTAIN GRASSLAND

Climate Influences

Colorado's non-shortgrass prairie grasslands are highly variable, depending on elevation and latitude. Foothill or piedmont grasslands are found at the extreme western edge of the Great Plains at elevations between 5,250 and 7,200 feet, where increasing elevation and precipitation facilitate the development of mixed to tallgrass associations on certain soils. Montane-subalpine grasslands in the Colorado Rockies are found at elevations of 7,200-10,000 feet, intermixed with stands of spruce-fir, lodgepole, ponderosa, and aspen, or as the matrix community in the large intermountain basin of South Park. Semi-desert grasslands are found primarily on dry plains and mesas in western Colorado at elevations of 4,750-7,600 feet. Our vulnerability analysis divided grasslands into those above and below 7,500 feet, roughly dividing montane-subalpine occurrences from the eastern and western lower elevation grassland types.

Higher elevation grasslands are characterized by cold winters and relatively cool summers, although temperatures are more moderate at lower elevations. Soil texture is important in explaining the existence of montane-subalpine grasslands (Peet 2000). Montane grasslands often occupy the fine-textured alluvial or colluvial soils of valley bottoms, in contrast to the coarse, rocky material of adjacent forested slopes (Peet 2000). Other factors that may explain the absence of trees in this system are soil moisture (too much or too little), competition from established herbaceous species, cold air drainage and frost pockets, high snow accumulation, beaver activity, slow recovery from fire, and snow slides (Daubenmire 1943, Knight 1994, Peet 2000). Where grasslands occur intermixed with forested areas, the less pronounced environmental differences mean that trees are more likely to invade (Turner and Paulsen 1976).

West Slope low-elevation grasslands occur in semi-arid to arid climates with cold temperate conditions. Hot summers and cold winters with freezing temperatures and snow are common. Grasslands of the western valleys receive a significant portion of annual precipitation in July through October during the summer monsoon storms, with the rest falling as snow during the winter and early spring months. Foothill grasslands of the eastern mountain front have a continental climate with both east-west and north-south gradients. Along the western edge of the plains, the Rocky Mountains create a rain shadow to the east. Precipitation rapidly increases with increasing elevation. Severe drought is also a common phenomenon in the Western Great Plains (Borchert 1950, Stockton and Meko 1983, Covitch et al. 1997). Temperature variation in the foothill zone is less than on the plains, with lower summer temperatures and higher winter

temperatures producing a climate is more moderate than that for grasslands to the east (Western Regional Climate Center 2004).

Drought and warmer temperatures may change species composition, or allow invasion by drought-tolerant trees/shrubs or invasive species in some areas. Drought can increase extent of bare ground and decrease forb coverage, especially in more xeric grasslands (Debinski et al. 2010), which could result in a transformation to a semi-desert grassland type.

Exposure and Sensitivity Summary

Foothill and montane grasslands are projected to experience both summer and winter temperatures that are warmer than the current range in about half of the current distribution, more so in lower elevation grasslands. Although projected winter precipitation levels are generally within the current range, annual precipitation levels are projected to be lower than the driest end of the current range for nearly half of the lower elevation distribution, and drought days are projected to increase in additional areas.

Climate variable	High elevation grasslands	Low elevation grasslands
	% projected range shift	
Winter precipitation	0%	1%
Annual precipitation	7%	44%
Drought days	5%	22%
Mean winter temperature	44%	64%
Mean summer temperature	55%	65%
Average range shift	22.1%	39.1%
Rank	M	H
Exposure-Sensitivity level	Moderate	High

Resilience Components

These foothill and montane grasslands are not restricted to high elevations, and are not at the southern edge of their North American distribution in Colorado.

Climatic variation, fire exclusion, and grazing appear to interact with edaphic factors to facilitate or hinder tree invasion in these grasslands (Zier and Baker 2006). The work of Coop and Givnish (2007) in the Jemez Mountains of northern New Mexico suggests that both changing disturbance regimes and climatic factors are linked to tree establishment in some montane grasslands.

Increased tree invasion into montane grasslands was apparently linked to higher summer nighttime temperatures, and less frost damage to tree seedlings; this trend could continue under projected future temperature increases. The interaction of multiple factors indicates that management for the maintenance of these montane and subalpine grasslands may be complex.

Floristic composition in grasslands is influenced by both environmental factors and grazing history. Many grassland occurrences are already highly altered from pre-settlement condition. Grazing is generally believed to lead to the replacement of palatable species with less palatable ones more able to withstand grazing pressure (Smith 1967, Paulsen 1975, Brown 1994, but see Stohlgren et al. 1999). Grazing by domestic livestock may act to override or mask whatever natural climatic or edaphic mechanism is responsible for maintaining an occurrence. This habitat is also adapted to grazing and browsing by native herbivores including deer, elk, bison, and pronghorn, as well as burrowing and grazing by small mammals such as gophers, prairie dogs, rabbits, and ground squirrels. Activities of these animals can influence both vegetation structure and soil disturbance, potentially suppressing tree establishment. Periodic drought is common in the range of foothill and semi-desert grasslands, but may not be as great a factor in the vegetation dynamics of this system as in grasslands of the plains.

Adaptive Capacity Summary

	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
High elevation grasslands	0.82	1	0.33	0.67	0.37	0.64	M	Moderate
Low elevation grasslands	0.71	1	0.33	0.67	0.37	0.62	M	Moderate

Vulnerability to Climate Change

Foothill & mountain grassland	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
High elevation	Moderate	Moderate	M/M	Moderate
Low elevation	High	Moderate	H/M	High

Foothill and mountain grasslands of elevations above 7,500 ft. are ranked as moderately vulnerable to the effects of climate change by mid-century under a moderate emissions scenario, and those below 7,500 ft. have high vulnerability. Primary factors contributing to this ranking are vulnerability of these area to invasive species, and the generally highly disturbed condition of

occurrences, both of which are likely to interact with the significant increases in temperature across much of the distribution of the habitat in Colorado to reduce resilience of these habitats. NOTE: due to the generally small size of montane-foothill grassland occurrences, exposure maps were not produced for this habitat.

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SHORTGRASS PRAIRIE

Climate Influences

Soil moisture level is a key determinant of the distribution of shortgrass prairie habitat; change in precipitation seasonality, amount, or pattern will affect soil moisture. Grasslands generally occur in areas where there is at least one annual dry season and soil water availability is lower than that required for tree growth (Parton et al. 1981, Sims and Risser 2000). Soil water availability acts on both plant water status and nutrient cycling (Sala et al. 1992). This habitat receives most of its annual precipitation during the spring and summer growing season. Daily precipitation amounts are typically quite small (5mm or less), and do not contribute significantly to soil water recharge, which instead is primarily dependent on large but infrequent rainfall events (Parton et al. 1981, Heisler-White et al. 2008). Larger rainfall events permit deeper moisture penetration in the soil profile, and enable an increase in above-ground net primary production (Heisler-White et al. 2008). The dominant shortgrass species blue grama (*Bouteloua gracilis*) is able to respond quickly to very small rainfall events, although this ability is apparently reduced during extended drought periods (Sala and Lauenroth 1982, Sala et al. 1982, Cherwin and Knapp 2012). Nevertheless, blue grama exhibited extensive spread during the drought of the Dustbowl years (Albertson and Weaver 1944). If large rainfall events are more common, the sensitivity of shortgrass prairie is reduced (Cherwin and Knapp 2012).

Grasslands in areas where mean annual temperature is above 10°C are generally dominated by C₄ (warm-season) grass species, which are tolerant of warmer temperatures and more efficient in water use (Sims and Risser 2000). In Colorado, shortgrass prairie has a historic annual mean temperature slightly greater than 10°C, although the range includes slightly cooler annual mean temperatures as well. Although these grasslands are adapted to warm, dry conditions, Alward et al. (1999) found that warming night-time temperatures in spring were detrimental to the growth of blue grama, and instead favored cool-season (C₃) species, both native and exotic. Consequently, the effect of increasing temperatures on shortgrass prairie is difficult to predict.

Warmer and drier conditions would be likely to reduce soil water availability and otherwise have detrimental effects on ecosystem processes, while warmer and wetter conditions could be favorable. Furthermore, changing climate may lead to a shift in the relative abundance and dominance of shortgrass prairie species, giving rise to novel plant communities (Polley et al. 2013). Because woody plants are more responsive to elevated CO₂, and may have tap roots capable of reaching deep soil water (Morgan et al. 2007), an increase of shrubby species (e.g., cholla, yucca, snakeweed, sandsage), or invasive exotic species, especially in areas that are disturbed (for instance, by heavy grazing) may also result.

Exposure and Sensitivity Summary

Shortgrass prairie is projected to experience spring and summer temperatures that are warmer than the current range in the majority of the current distribution. Projected precipitation levels are projected to be lower than the driest end of the current range for nearly half of the lower elevation distribution. An increase in drought days, and fewer days with large precipitation events are projected for a substantial portion of the current distribution as well.

Shortgrass prairie

Climate variable (sources: M=model, E = expert review, L = literature review)	% projected range shift
Annual precipitation (L)	43%
Days with heavy precipitation (L)	30%
Drought days (M, E, L)	38%
Mean spring temperature (L)	58%
Mean summer temperature (L)	67%
Average range shift	41.2%
Rank	H
Exposure-Sensitivity level	High

Resilience Components

In spite of extensive conversion to agriculture or other uses, shortgrass prairie still forms extensive tracts on the eastern plains of Colorado, at elevations below 6,000 feet. Colorado accounts for a substantial portion of the North American distribution of these grasslands, which extend from Texas to Wyoming. Shortgrass prairie experiences a much drier and warmer climate than most other habitat types in Colorado. Annual average precipitation is on the order of 10-18 inches (25-47 cm), with a mean of 15 in (38 cm), and the growing season is generally long, with frequent high temperatures.

The short grasses that characterize this habitat are extremely drought- and grazing-tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing. Fire is less important than herbivory in shortgrass habitat; the typically warm and dry climate conditions act to decrease the fuel load and thus the relative fire frequency within the habitat. Historically, fires that did occur were often extensive; fire suppression and grazing have greatly changed this tendency. More frequent occurrence of

climate extremes (e.g., very wet conditions followed by very dry conditions) could increase the frequency and extent of grassland wildfires (Polley et al. 2013).

Adaptive Capacity Summary

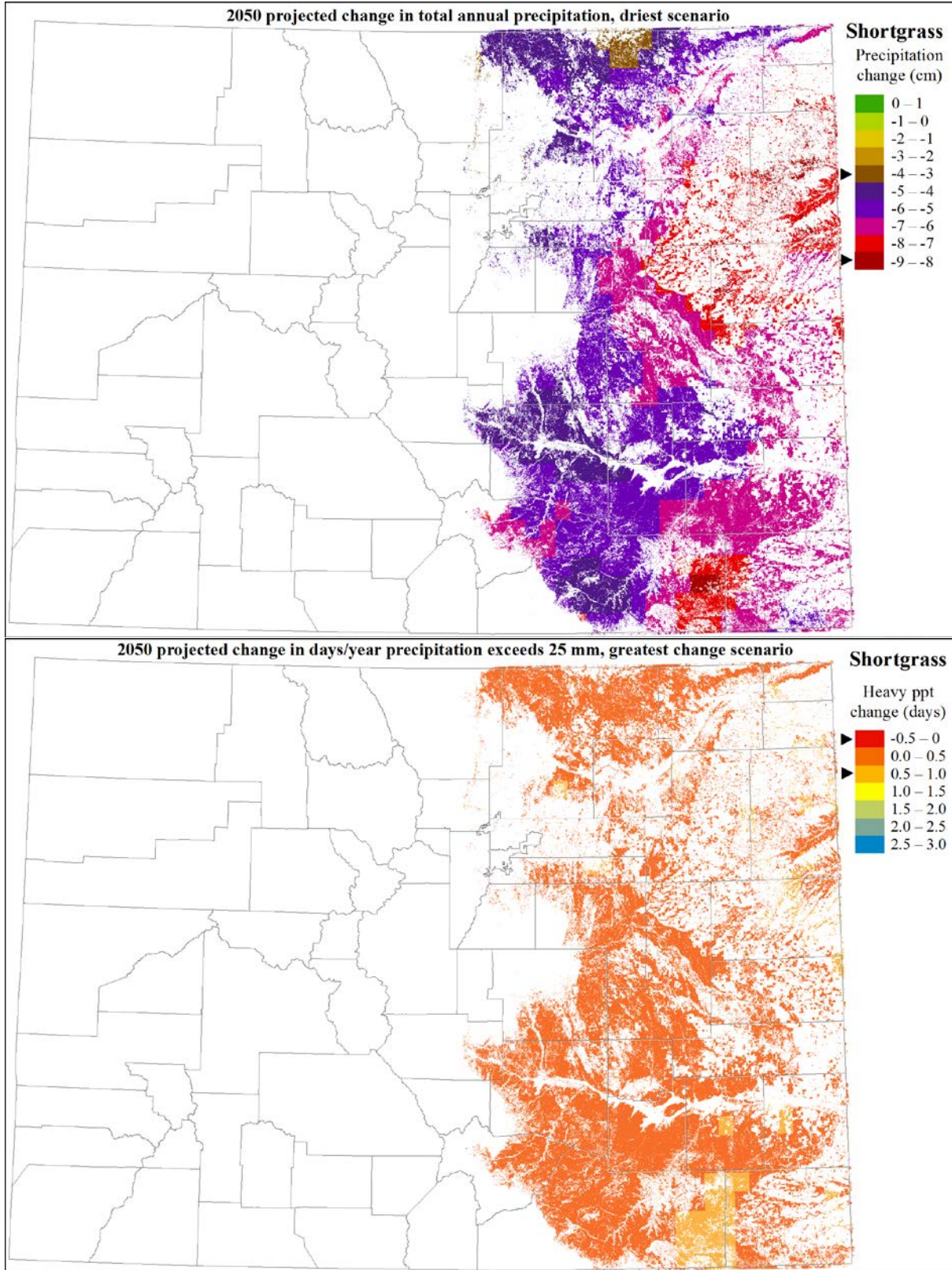
	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Shortgrass	0.69	1	0.33	0.67	0.44	0.62	M	Moderate

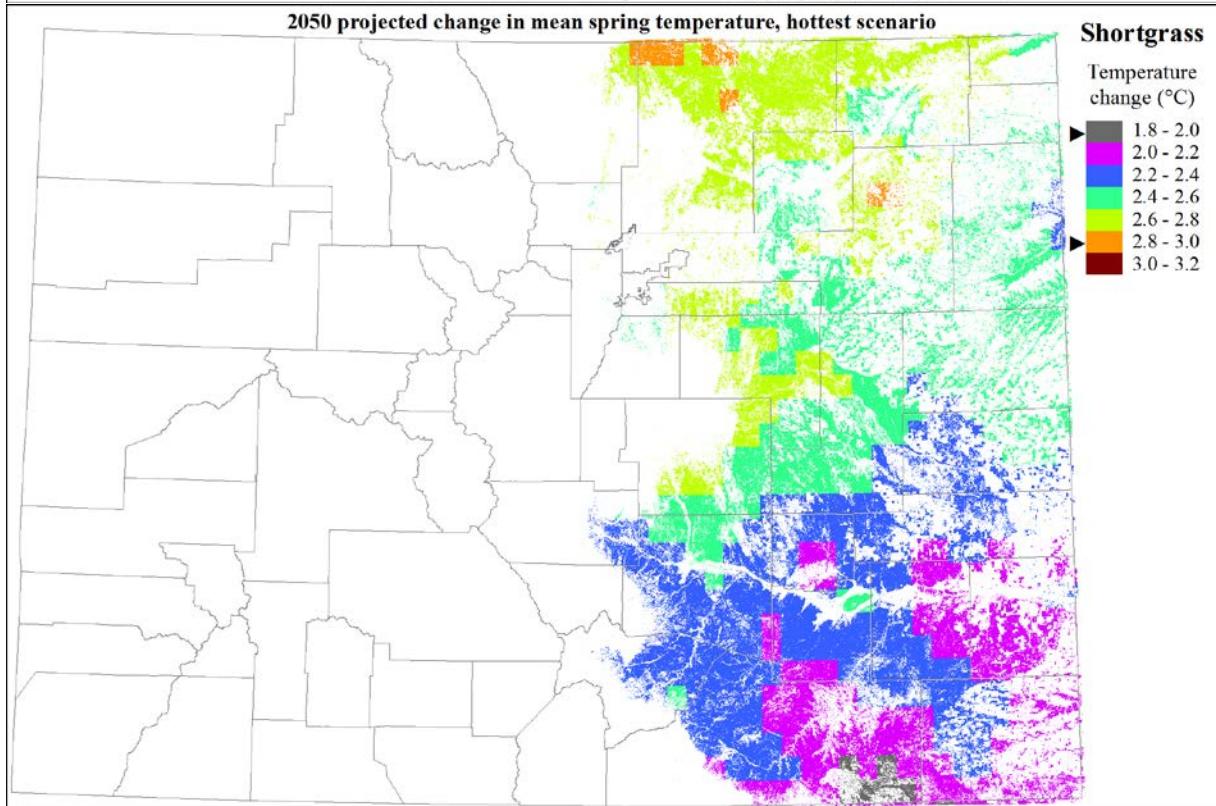
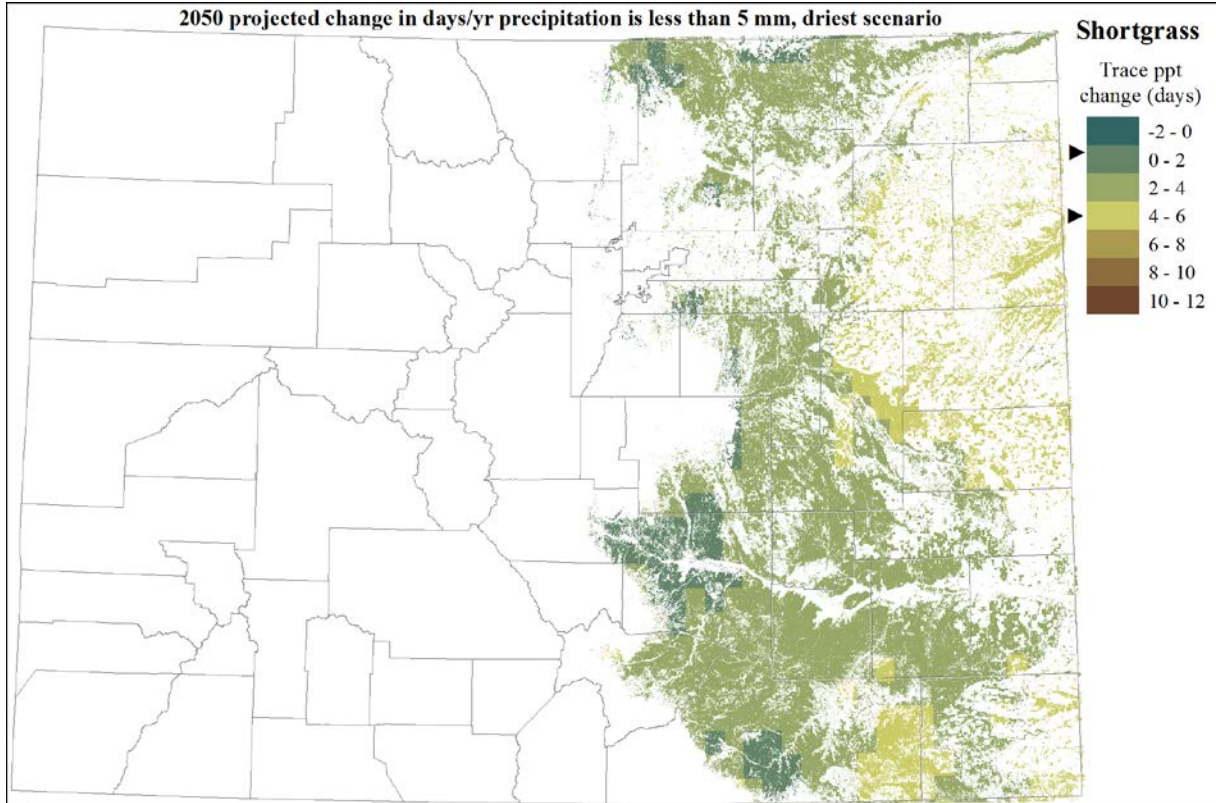
Vulnerability to Climate Change

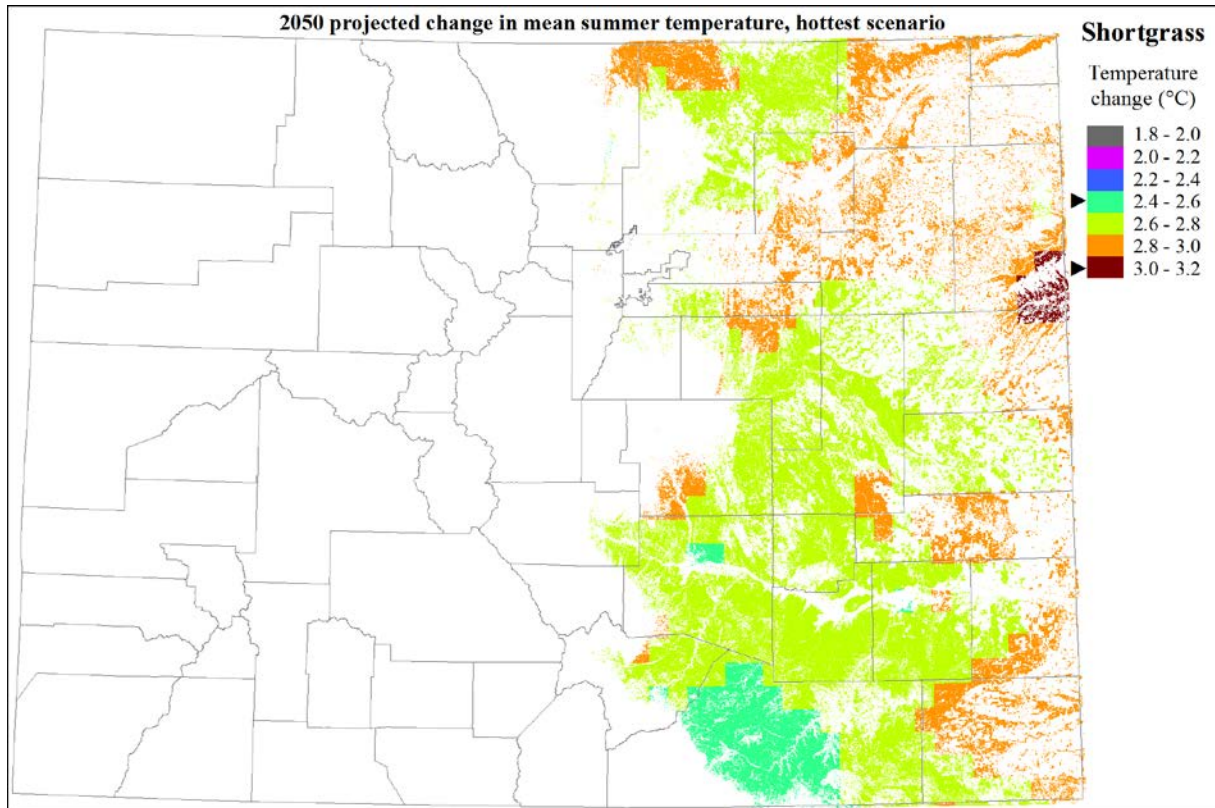
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Shortgrass prairie	High	Moderate	H/M	High

Shortgrass prairie is ranked as having high vulnerability to the effects of climate change by mid-century under a moderate emissions scenario. Primary factors contributing to this ranking are the fact that these grasslands are found on the eastern plains of Colorado, where the greatest levels of exposure for all temperature variables occur. In addition, anthropogenic disturbance in these grasslands has reduced the overall landscape condition of the habitat, which is likely to reduce its resilience in the face of increasing frequency of extreme events.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for shortgrass habitats. Legend pointers indicate the range of change for this habitat within the statewide extent of change. For the driest projection, annual precipitation could be 4-8 cm less than current levels, with a reduction in heavy precipitation events even under wetter scenarios, and increase in days with little to no measurable precipitation. Spring and summer temperatures are projected to increase by 2.5-3°C in the warmest scenario across the distribution of this habitat, which is likely to increase drought stress for shortgrass prairie.







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PLAYAS

Climate Influences

Playas of Colorado's eastern plains are small, shallow, isolated temporary wetlands, each within a closed watershed. In the absence of anthropogenic disturbance, playas receive water only from precipitation and associated runoff, and water is lost through evaporation, transpiration, and infiltration (Haukos and Smith 2003). Wet and dry periods are dependent on local patterns of precipitation and temperature both seasonally and from year to year. In common with the surrounding shortgrass prairie habitat, playas in eastern Colorado receive most of their limited annual precipitation in the form of rain during the period April through September (WRCC 2004). Unmodified playas are normally dry in late winter and early spring (Bolen et al. 1989). Most precipitation events are small (5mm or less), but infrequent heavy rainfall events are characteristic of the region. The biodiversity of a playa in a given year is a product of both current and past conditions that permit the growth of vegetation from the seed bank, and support associated fauna (Haukos and Smith 1993).

Colorado's eastern plains generally experience a large daily range in temperature, and summer temperatures are generally higher than in other areas of the state, or equivalent to the warmest low-elevation areas in southwest Colorado. The warm, dry conditions of late summer facilitate the evaporation of standing water, as well as transpiration by playa vegetation. Extended periods of drought and attendant dust storms are characteristic of the region (WRCC 2004).

Changes in the amount and timing of precipitation, as well as the effect of increasing temperature on evapotranspiration rates are likely to alter the hydroperiod of individual playas, and, in aggregate, the number and distribution of playas on the landscape (Matthews 2008). Decreases in precipitation are likely to increase fragmentation of playa lakes as a landscape level habitat resource, such that species utilizing these habitats will face increased difficulty in moving between playas (McIntyre et al. 2014, Ruiz et al. 2014).

Exposure and Sensitivity Summary

Projected precipitation levels for playas are generally within the current range. Spring and summer temperatures are projected to be warmer than the current range in more than half of the distribution of this habitat.

Playas

Climate variable	% projected range shift
Spring precipitation	0%
Summer precipitation	0%
Drought days	0%
Mean spring temperature	58%
Mean summer temperature	56%
Average range shift	23%
Rank	M
Exposure-Sensitivity level	Moderate

Resilience Components

Playas in eastern Colorado are not restricted to high elevations, and are not at the southern edge of their range. However, these factors may not be as relevant to determining vulnerability for these small, isolated habitat patches as for larger, more contiguous habitat types. Playas in eastern Colorado occur in a relatively small range of precipitation and growing season conditions. Furthermore, the small size, isolation, and dynamic nature of these habitats mean that connectivity and dispersal are critical points of vulnerability in the persistence of these habitats and the species that rely on them.

Increased sedimentation through water erosion of adjacent cultivated lands and active filling of depressional wetlands has been the primary threat to the persistence of playa habitats (Haukos and Smith 2003). Far fewer than 1% of extant playas are without modification, either to the wetland itself, or to its watershed (Johnson et al. 2012). Anthropogenic alterations to hydrology within individual playas include tilling, pit excavation to increase water storage, runoff diversion, and pumping for irrigation. Additional land use practices within the immediate watershed may include crop cultivation, livestock grazing, development, and other practices that increase sediment accumulation in the playa (Luo et al. 1997, Johnson et al. 2012). Impacts to playas from conversion to cropland are significant, and tend to decrease the resilience of the playa habitat. Tilling decreases the ability of a playa depression to maintain natural hydroperiod (Tsai et al. 2007), and increases the chance of colonization by exotic species (Tsai et al. 2012). The highly altered condition of playa habitat is likely to significantly degrade the ability of these wetlands to adapt to climate change.

Adaptive Capacity Summary

	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Playas	0.62	0.00	0.33	0.67	0.57	0.44	L	Low

Vulnerability to Climate Change

	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Playas	Moderate	Low	M/L	High

Playas are ranked as having high vulnerability to the effects of climate change by mid-century under a moderate emissions scenario. The primary factor contributing to this ranking is the fact that these isolated wetlands are found on the eastern plains of Colorado, where the greatest levels of exposure for all temperature variables occur. In addition, anthropogenic disturbance in these has reduced the overall landscape condition and connectivity of the habitat, which is likely to reduce its resilience in the face of increasing frequency of extreme events, and generally warmer, drier conditions.

NOTE: due to the generally small size of playa occurrences, exposure maps were not produced for this habitat.

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RIPARIAN WOODLANDS AND SHRUBLANDS

Climate Influences

We assessed the condition of riparian woodlands and shrublands in each of three regions in Colorado, corresponding roughly to ecoregions as defined by The Nature Conservancy (2009, modified from Bailey 1998): the eastern plains (Central Shortgrass Prairie ecoregion); mountains (Southern Rocky Mountain ecoregion); and western plateaus and valleys (Colorado Plateau, Wyoming Basins, and other ecoregions).

Riparian areas of Colorado's eastern plains are primarily associated with intermittently flowing streams of small to moderate size, but also include the larger floodplains of the large snowmelt-fed rivers (South Platte and Arkansas). Smaller streams receive water from precipitation and groundwater inflow; have greater seasonal flow variation than the larger rivers; and have minimal or no flow except during floods (Covich et al. 1997). In mountainous areas of Colorado, riparian areas are much more likely to be associated with perennially flowing streams, and these plant communities are adapted to high water tables and periodic flooding. Runoff and seepage from snowmelt is a primary source of streamflow. Lower elevation riparian areas in western Colorado are adapted to periodic flood disturbance and predominantly arid conditions. Larger streams and rivers are sustained by runoff from mountain areas. Smaller streams are primarily supported by groundwater inflow, or occasional large precipitation events, and are often dry for some portion of the year.

Riparian woodlands and shrublands are adjacent to and affected by surface or ground water of perennial or ephemeral water bodies. They are characterized by intermittent flooding and a seasonally high water table. The close association of riparian areas with streamflow and aquatic habitats means that changing patterns of precipitation and runoff that alter hydrologic regimes are likely to have a direct effect on these habitats (Capon et al. 2013). In addition, the interaction of increased growth due to increased CO₂ concentration, warming-induced drought and heat-stress with potentially reduced streamflows are likely to affect riparian community structure and composition, especially in more arid areas (Perry et al. 2012).

Climate projections for mid-century are generally for warmer and drier outcomes, although precipitation change is more uncertain in direction and magnitude (Lucas et al. 2014). Annual runoff and streamflow are affected by both temperature and precipitation, and effects of future changes in these factors are difficult to separate. Warming temperatures are likely to affect the

hydrologic cycle by shifting runoff and peak flows to earlier in the spring, and reducing late summer-early autumn flows (Rood et al. 2008). Riparian vegetation is in part determined by flow levels (Auble et al. 1994). Reduced summer flows are predicted to result in more frequent drought stress for riparian habitats, with a resulting loss or contraction of the habitat (Rood et al. 2008). Warming-induced changes in snowpack and snowmelt timing include earlier spring snowmelt, a shift towards precipitation falling as rain instead of snow in spring and fall, and increased sublimation from the snowpack throughout the season. These changes are expected to have greater impact at lower elevations (Lucas et al. 2014).

Exposure and Sensitivity Summary

Because of the widespread nature and generally wide ecological tolerances of this diverse group of plant communities as a whole, projected temperature and precipitation conditions across the complete current distribution are generally within the current range. Riparian woodlands and shrublands in western Colorado are projected to experience summer temperatures that are warmer than the current range in nearly half of the current distribution. In eastern Colorado, projected precipitation levels are projected to be lower than the driest end of the current range for 15% of the current distribution, and drought days are projected to increase as well.

Riparian woodland and shrubland	West	Mountain	East
Climate variable	% projected range shift		
Winter precipitation		0%	
Spring precipitation		0%	15%
Summer precipitation	0%		0%
Fall precipitation	0%		
Days with heavy precipitation		0%	
Drought days			38%
Mean winter temperature		0%	
Mean spring temperature	0%	0%	0%
Mean summer temperature	43%		0%
Very hot days	0%		
Average range shift	9%	0%	11%
Rank	L	L	L
Exposure-Sensitivity level	Low	Low	Low

Resilience Components

Riparian areas have a wide ecological amplitude in Colorado, and are not restricted by elevation or edge-of-range factors. However, the structure and composition of riparian habitats is closely tied to local as well as upstream environmental conditions, and is consequently highly variable from one part of the state to another. Changing climates could have dramatic effects on the component species and arrangement of riparian habitats; the consequences of these changes for habitat function and persistence are little known.

Dominant riparian species are often dependent on periodic flood disturbance for dispersal and regeneration. Altered hydrology due to dams, diversions, and groundwater pumping may interact with warming temperatures and changes in precipitation pattern to alter fluvial regimes. Such changes may increase vulnerability of riparian habitats to invasion by exotic species, especially after extreme events (Capon et al. 2013). Increased frequency and magnitude of drought is likely to have more impact on these habitats than stream warming or wildfire, at least at regional scales (Holsinger et al. 2014). Climate change in water source areas as well as in adjacent habitats could have significant impact on riparian habitats, potentially reducing vegetative cover, and altering species composition.

Adaptive Capacity Summary

Riparian woodland and shrubland	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
West	0.57	0.50	0.33	0.67	0.40	0.50	L	Low
Mountain	0.81	0.50	0.33	0.67	0.69	0.60	M	Moderate
East	0.64	0.50	0.33	0.67	0.44	0.52	M	Moderate

Vulnerability to Climate Change

Riparian woodland & shrubland	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
West	Low	Low	L/L	Moderate
Mountain	Low	Moderate	L/M	Low
East	Low	Moderate	L/M	Low

Riparian woodland and shrublands of the eastern plains and mountain areas are ranked as having low vulnerability to the effects of climate change by mid-century under a moderate emissions scenario, while those of the western valleys are considered moderately vulnerable.

Primary factors contributing to these rankings are the wide ecological amplitude and distribution of riparian habitats throughout Colorado, although the vulnerability of some species assemblages may be higher than is reflected by the collective assessment. The low to moderate resilience ranks reflect the highly altered condition of most of these habitats, and in general, riparian woodlands and shrublands throughout the state should probably be regarded as having some degree of vulnerability to climate change that is not captured by our broad-scale assessment methods. NOTE: due to the relatively small size of riparian occurrences, exposure maps were not produced for this habitat.

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WETLANDS

Climate Influences

We assessed the condition of non-riparian wetlands in each of three sections of Colorado, corresponding approximately to ecoregions as defined by The Nature Conservancy (2009, modified from Bailey 1998): the eastern plains (Central Shortgrass Prairie ecoregion); mountains (Southern Rocky Mountain ecoregion); and western plateaus and valleys (Colorado Plateau, Wyoming Basins, and other ecoregions).

As considered herein, wetlands are areas characterized by water saturation and hydric soils typically supporting hydrophytic vegetation. Non-riparian wetlands of Colorado's eastern plains and western valleys are primarily marshes, seeps, and springs, and wet meadows. Although natural marshes and wet meadows are primarily found at higher elevations, irrigation practices (direct flood application, irrigation tail waters, elevated groundwater levels, etc.) have greatly increased the incidence of wet meadows on the eastern plains (Sueltenfuss et al. 2013). Playas are considered separately above. Most of the state's wet meadows occur in mountainous areas of Colorado, and marshes are generally less common. Fens are also characteristic of the mountain region.

Effects of climate change on wetlands are expected to be largely mediated through the source of water, either precipitation, groundwater discharge, or, for wetlands associated with riparian areas, surface flow (Winter 2000). Precipitation supported wetlands are thought to be most vulnerable to drier climatic outcomes, but decreasing precipitation would also be likely to lower water table levels and lead to contraction of groundwater-fed wetlands (Winter 2000, Poff et al. 2002). Under wetter conditions, some wetland types may be able to expand or at least maintain current extents. Consideration of the effects of changing precipitation is further complicated by the fact that wetlands may receive water input from the surrounding basin, not just the immediate environs (Gitay et al. 2001).

Temperature affects wetland distribution and function primarily through its effects on rates of chemical, physical and biological processes (Gage and Cooper 2007). Although wetlands are to some extent buffered from the immediate effects of warming on water temperature, warming could increase both plant growth and microbial activity driving decomposition (Fischlin et al. 2007). Temperature is also a driver of evapotranspiration rate, and the water cycle in general (Gitay et al. 2001).

Variation in climatic conditions affects groundwater levels both directly via recharge rates, and indirectly through changes in patterns of groundwater use, especially irrigation (Taylor et al.

2012). Drier future conditions are likely to result in tighter controls on irrigation seepage, and a consequent reduction in wetland acres supported by this source. Although climate change is expected to have a significant effect on wetlands through changes in the seasonality and variability of precipitation and extreme events (Gitay et al. 2002), changing water use patterns in response to climate change are also likely to play a major role in the future of wetlands (Taylor et al. 2012).

Exposure and Sensitivity Summary

These habitats have a wide distribution in Colorado, and as a whole are generally less exposed than are individual wetland occurrences. In western Colorado, projected summer and fall precipitation are drier than conditions for the current distribution in some areas, and the number of very hot days is likely to increase for about a third of the distribution there. Wetlands in the mountain areas of the state are most likely to see drier than current conditions in the winter and spring. Wetland habitats of the eastern plains are most likely to see summer temperatures warmer than the current range, drier spring and summer, and increased drought days in comparison to the current range.

Wetland	West	Mountain	East
Climate variable	% projected range shift		
Winter precipitation		19%	
Spring precipitation		4%	6%
Summer precipitation	14%		12%
Fall precipitation	6%		
Days with heavy precipitation		0%	
Drought days			29%
Mean winter temperature		0%	
Mean spring temperature	0%	0%	0%
Mean summer temperature	0%		67%
Very hot days	32%		
Average range shift	10%	5%	23%
Rank	L	L	M
Exposure-Sensitivity level	Low	Low	Moderate

Resilience Components

Wetlands have a wide ecological amplitude in Colorado, and are not restricted by elevation or edge-of-range factors. The potential aggregation of basin wide effects into wetland areas increases the chance for changes to have an impact over considerable distances. Changing climates could have dramatic effects on the component species and hydrologic cycles of wetlands; the consequences of these changes for habitat function and persistence are likely to be significant. Because many wetlands are small and relatively isolated within the landscape, habitat connectivity and species dispersal are a point of vulnerability.

Wetland habitats have been heavily impacted by anthropogenic activities, especially water management (Gage and Cooper 2007). Altered hydrology due to dams, diversions, and groundwater pumping may interact with warming temperatures and changes in precipitation pattern to alter groundwater recharge rates, and lead to drying or contraction of wetlands. Impacted wetlands may be more vulnerable to invasion by exotic species. Increased frequency and magnitude of drought is likely to have significant impact on these habitats. Climate change in water source areas as well as in adjacent habitats could have significant impact on wetlands.

Adaptive Capacity Summary

Wetlands	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
West	0.69	0.50	0.33	0.67	0.41	0.52	M	Moderate
Mountain	0.90	0.50	0.33	0.67	0.67	0.61	M	Moderate
East	0.66	0.50	0.33	0.67	0.43	0.52	M	Moderate

Vulnerability to Climate Change

Wetlands	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
West	Low	Moderate	L/M	Low
Mountain	Low	Moderate	L/M	Low
East	Moderate	Moderate	M/M	Moderate

Wetland habitats of the western valleys and mountain areas are ranked as having low vulnerability to the effects of climate change by mid-century under a moderate emissions scenario, while those of the eastern plains are considered moderately vulnerable. Primary factors

contributing to these rankings are the wide ecological amplitude and distribution of wetland habitats throughout Colorado, although the vulnerability of some species assemblages may be higher than is reflected by the collective assessment. The moderate resilience ranks reflect the highly altered condition of most of these habitats, and in general, wetlands throughout the state should probably be regarded as having some degree of vulnerability to climate change that is not captured by our broad-scale assessment methods.

NOTE: due to the generally small size of wetland occurrences, exposure maps were not produced for this habitat.

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ALPINE

Climate Influences

Snowpack is a crucial component of alpine ecosystems, and depends on both precipitation amounts and winter-spring temperature (Williams et al. 2002). Vegetation in alpine areas is controlled by patterns of snow retention, wind desiccation, permafrost, and a short growing season (Greenland and Losleben 2001). Drier areas are often characterized by a dense cover of low-growing, perennial graminoids and forbs. Rhizomatous, sod-forming sedges are the dominant graminoids, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs. Low-growing shrublands characterized by an intermittent layer of snow willow or dwarf-shrubs less than 0.5 m in height, with a mixture of forbs and graminoids (especially sedges) are typically found in areas of level or concave glacial topography, with late-lying snow and sub-irrigation from surrounding slopes.

The length of the growing season is particularly important for the alpine zone, and for the transition zone between alpine and forest (treeline). Alpine areas have the fewest growing degree days and lowest potential evapotranspiration of any habitat in Colorado. Treeline-controlling factors operate at different scales, ranging from the microsite to the continental (Holtmeier and Broll 2005). On a global or continental scale, there is general agreement that temperature is a primary determinant of treeline. At this scale, the distribution of alpine ecosystems is determined by the number of days that are warm enough for alpine plant growth, but not sufficient for tree growth. Other alpine conditions that maintain treeless vegetation at high elevations include lack of soil development, persistent snowpack, steep slopes, wind, and dense turf that restricts tree seedling establishment and survival within the treeline ecotone (Moir et al. 2003, Smith et al. 2003, Holtmeier and Broll 2005).

On the basis of historic evidence, treeline is generally expected to migrate to higher elevations as temperatures warm, as permitted by local microsite conditions (Smith et al. 2003, Richardson and Friedland 2009, Grafius et al. 2012). It is unlikely that alpine species would be able to move to other alpine areas. In the short-term with warmer temperatures, alpine areas may be able to persist, especially in areas where it is difficult for trees to advance upslope. The slow growth of woody species and rarity of recruitment events may delay the conversion of alpine areas to forest for 50-100+ after climatic conditions have become suitable for tree growth (Körner 2012). Thus, alpine ecosystems may persist for a while beyond mid-century, but are likely to eventually largely disappear from Colorado in the long run.

Exposure and Sensitivity Summary

Alpine habitats are projected to experience temperatures warmer than the current range in more than half of their current distribution. Projected winter and spring precipitation levels are generally within the range of the current distribution.

Alpine

Climate variable <small>(sources: M=model, E = expert review, L = literature review)</small>	% projected range shift
Winter precipitation (M, L)	0%
Spring precipitation (M)	4%
Days with heavy precipitation (M, L)	0%
Mean summer temperature (M, L)	56%
Growing degree days - base 0 (L)	51%
Average range shift	22.1%
Rank	M
Exposure-Sensitivity level	Moderate

Resilience Components

Elevations of alpine habitats in Colorado range from about 11,000 to over 14,000 ft., with a mean of about 12,000 ft. Alpine habitats are restricted to high elevations, and are also near the southern extent of their continental range in Colorado. Statewide, the annual average precipitation range is about 20-60 in (50-150 cm) with a mean of 36 in (92.5 cm). Alpine growing seasons are the shortest of any habitat in Colorado.

Alpine environments are generally not susceptible to outbreaks of pest species or disease, but may have some slight vulnerability to invasive plant species such as yellow toadflax. These treeless environments are not vulnerable to fire, but could become so if trees are able to establish. Xeric alpine environments are already subject to extreme conditions, but the more mesic areas are vulnerable to drought and changes in snowmelt timing. Even under increased snowpack, warmer temperatures are likely to alter patterns of snowmelt, and may reduce available moisture. These changes are likely to result in shifts in species composition, perhaps with an increase in shrubs on xeric tundra. With warming temperatures and earlier snowmelt, however, elk may be able to move into alpine areas earlier and stay longer, thereby increasing stress on alpine willow communities (Zeigenfuss et al. 2011).

Alpine habitats are also indirectly affected by both drought and land-use practices in upwind areas that lead to dust emissions. When wind-blown dust is deposited on mountain snowpack, the resulting darkening of the snow allows increased absorption of solar radiant energy, and earlier melting than under dust free conditions. Unlike warming temperatures, which advance both snowmelt timing and growing season onset for alpine vegetation, the effect of dust deposition on mountain snowpack is also a source of earlier snowmelt, and is not directly linked to seasonal warming (Steltzer et al. 2009). Although dust deposition may be a significant contributor to soil development in some areas (Lawrence et al. 2011), it can increase evapotranspiration and decrease annual runoff flows (Deems et al. 2013). Changes in soil moisture levels due to earlier snowmelt may interact with other climate change effects to produce changes in species composition and structure of alpine habitats.

Adaptive Capacity Summary

	Range and biophysical envelope	Dispersal & growth form	Biological stressors	Extreme events	Landscape condition	Resilience - Adaptive capacity score	Rank	Resilience Level
Alpine	0.32	0.5	0.67	0.67	0.98	0.61	M	Moderate

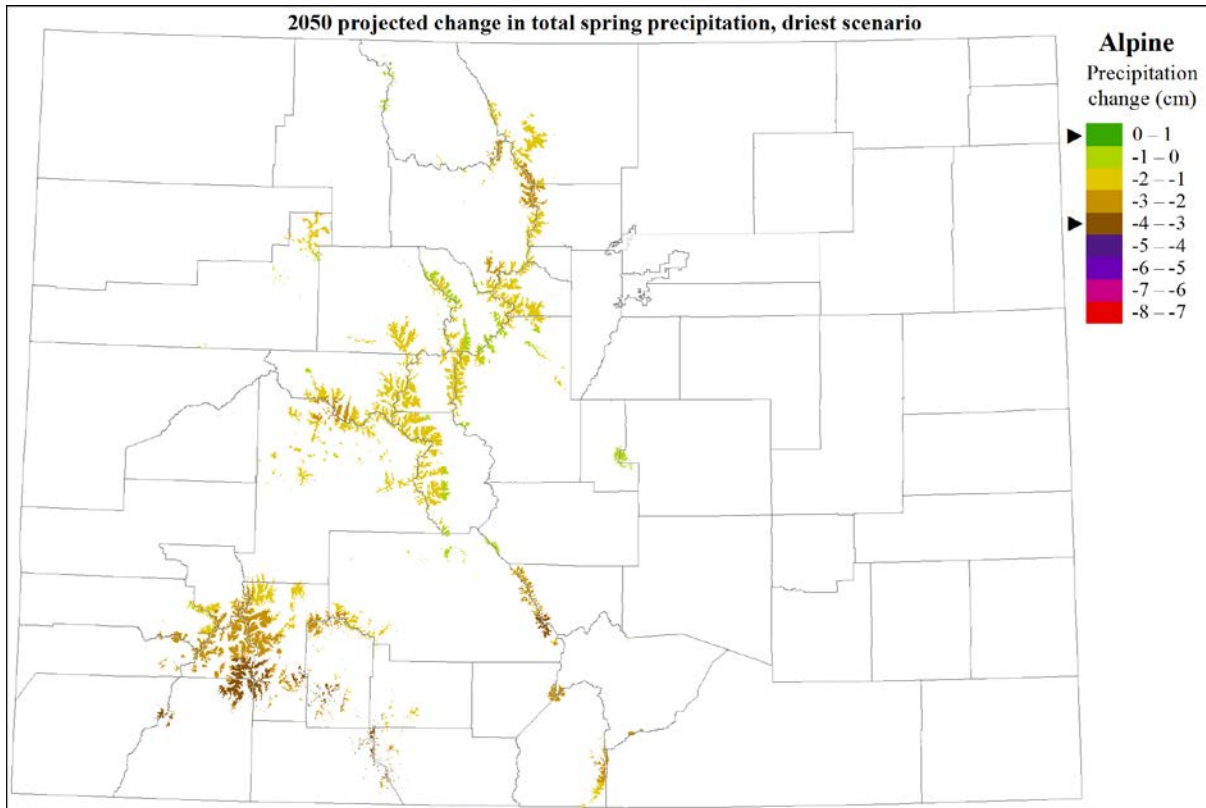
Vulnerability to Climate Change

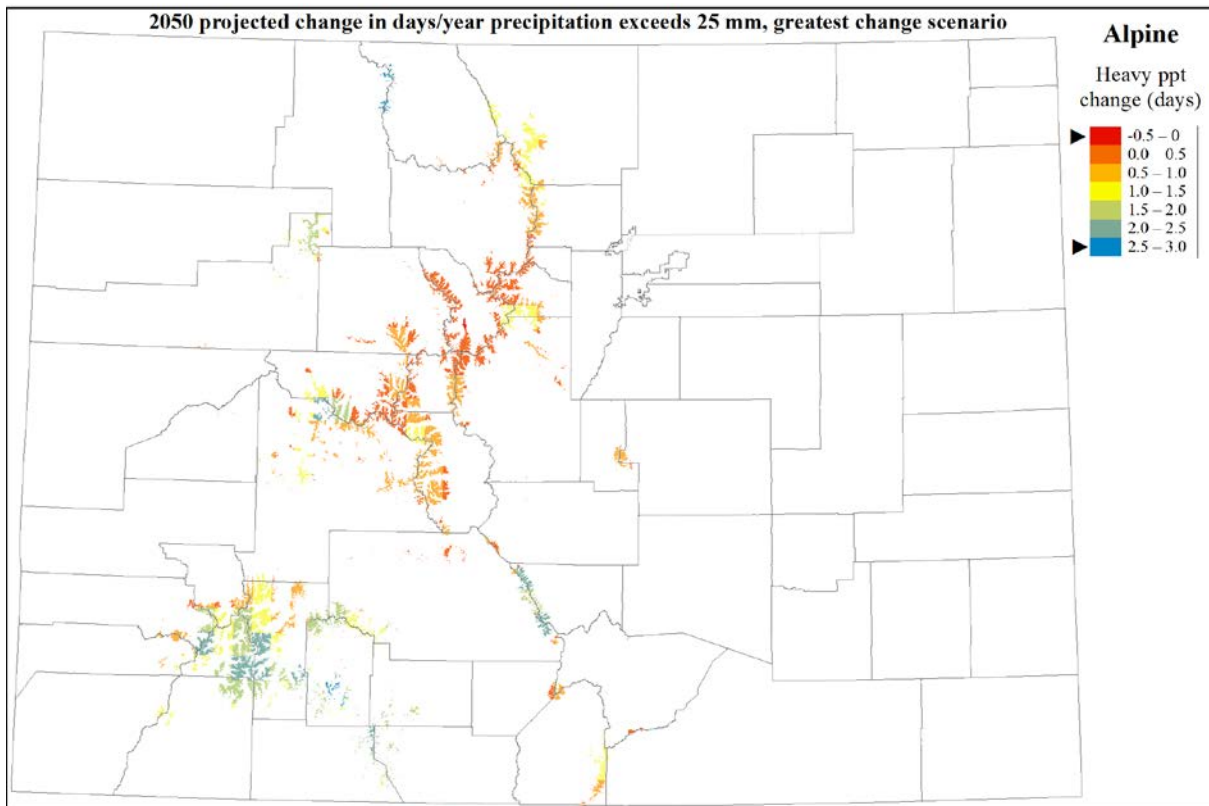
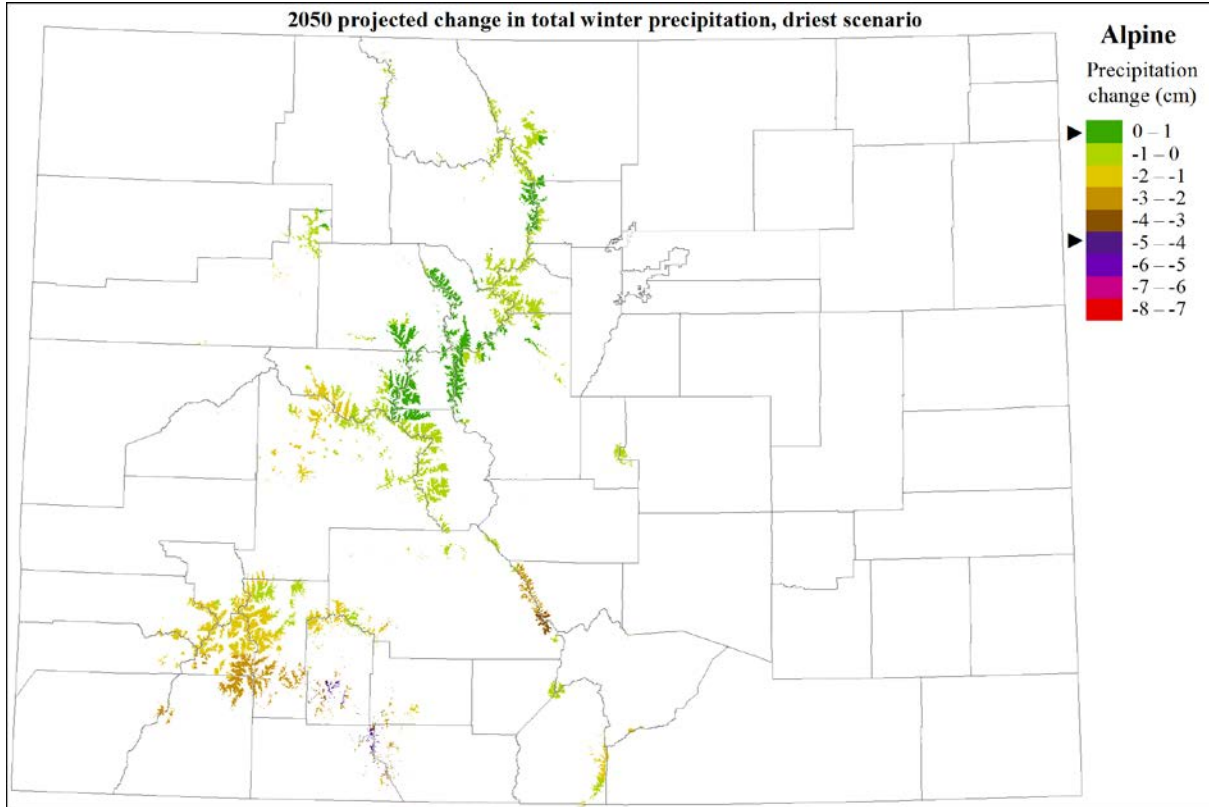
	Exposure - Sensitivity	Resilience – Adaptive Capacity	Combined rank	Overall vulnerability to climate change
Alpine	Moderate	Moderate	M/M	Moderate

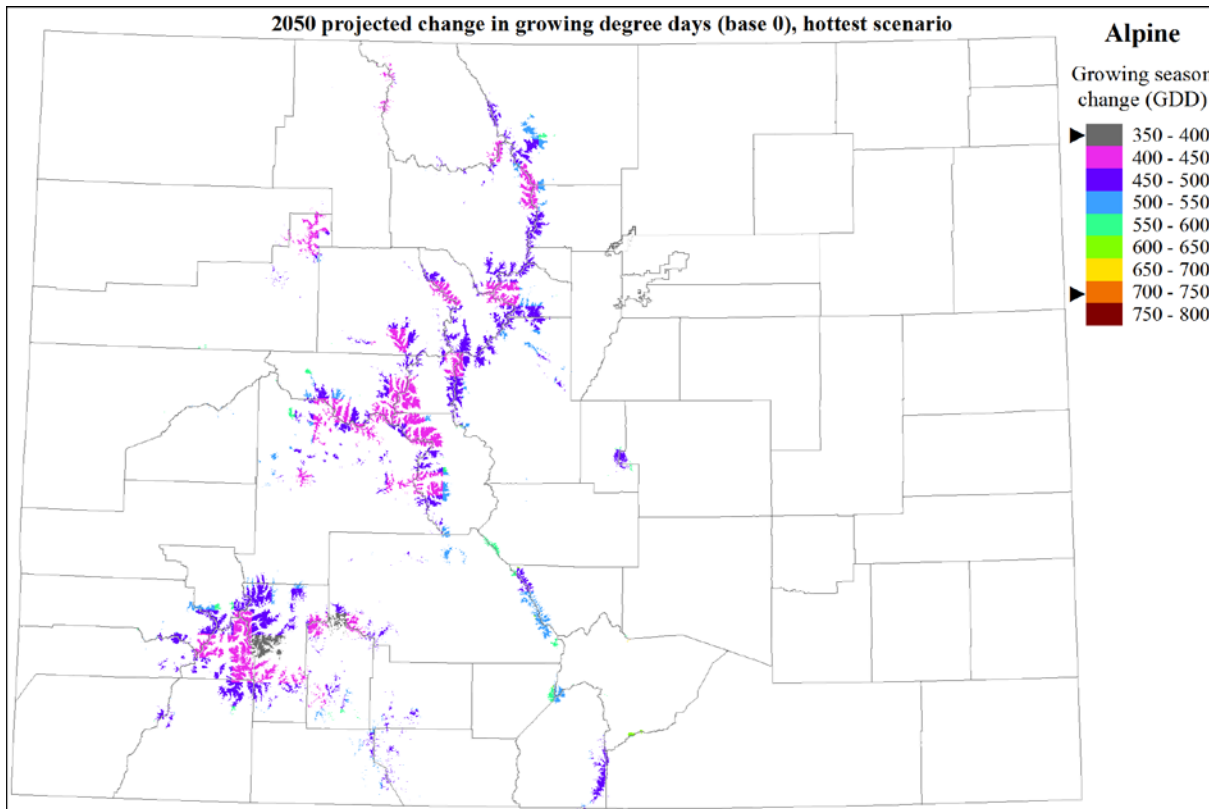
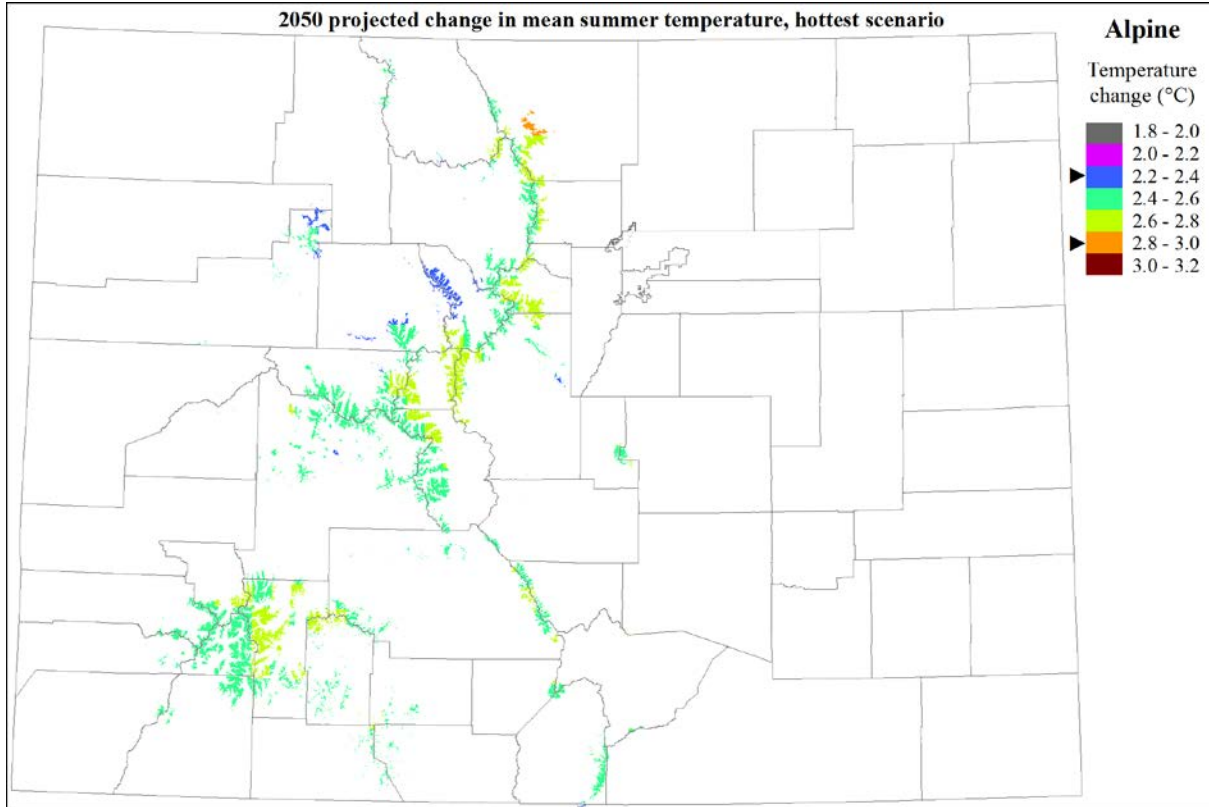
Alpine habitats are ranked moderately vulnerable to the effects of climate change by mid-century under a moderate emissions scenario. Primary factors contributing to this ranking are the fact that these habitats are restricted to the highest elevations of Colorado, and consequently have a narrow biophysical envelope. Many of the constituent species are at the southern edge of their distribution in Colorado. Under a longer-term evaluation frame, vulnerability of this habitat is expected to be greater.

Maps below illustrate the spatial pattern of exposure under the worst case scenario for the five climate variables assessed for alpine habitats. Legend pointers indicate the range of change for this habitat within the statewide extent of change. Alpine areas in the San Juan Mountains are generally most exposed to drier conditions. Under a wetter scenario, however, some parts the southern mountains may experience an increase in large precipitation events. Temperature

patterns are less clear; all areas are projected to undergo warming to some degree, although to a lesser extent than is projected for lower elevation habitats.







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Appendix G: State of Colorado's Biodiversity – Executive Summary



THE STATE OF
COLORADO'S
BIODIVERSITY



EXECUTIVE SUMMARY

Colorado is a “must see” state for many, thanks to its majestic scenery, abundant recreation opportunities, and pleasing climate. We are blessed with a diversity of ecosystems, ranging from the high alpine peaks of the Continental Divide, to the rolling prairies and deep canyonlands of our eastern prairies and western plateaus. We are also faced with many management challenges, including population growth and energy development.

Many groups, including federal, state, and local governments, as well as private conservation organizations, are working together on conserving and managing our state's biological diversity. Although there are many eyes on biodiversity issues, there is still not enough time, money, and - in some cases - political will, to conserve all of Colorado's remaining native landscapes. Thus, setting well thought-out priorities for conservation action is essential.

Conservationists and planners need methods to identify priority areas for conservation, information on how to characterize the relative importance, quality, and urgency of these areas (inform conservation strategies), and a means to measure conservation success on a regional or statewide basis over time. In order to assist the Colorado office of The Nature Conservancy with their “Measures of Success” program, and to provide biodiversity status information to other organizations in Colorado, the Colorado Natural Heritage Program has developed a prototype analysis of the status of Colorado's biodiversity, using a “scorecard” approach.

Following the three-part model of “effective conservation” developed by The Nature Conservancy, our scorecard evaluated the status of ecological systems, at-risk animals, and rare plants under three broad categories: 1) Biodiversity status – including size, quality, and landscape integrity; 2) Threat status – focused on both current and potential future impacts; and

3) Protection status. This scorecard includes 18 ecological systems, 113 of Colorado's at-risk vertebrate animal species, and 103 of our rarest plant species.

This biodiversity scorecard provides a snapshot of the current conservation status of our rare and imperiled species, and our most widespread ecological systems. We took a systematic and repeatable approach to these assessments, focusing on: quality, quantity, threats, and level of current protection. Resulting scores for these factors were then combined to produce an overall conservation status score. Successful implementation of a comprehensive conservation strategy should result in maintaining or improving these scores over time.

This report is not a strategy for achieving conservation success. Rather, it is a guide to help set conservation priorities, and to develop those strategies that are needed to ensure the long-term

viability of all of our biological resources.

Ecological Systems

Our analysis shows that, while Colorado's dominant ecological systems are still largely intact, many of them are threatened and/or not well protected. Common and widespread ecological systems in Colorado are generally of good to high quality and part of naturally functioning landscapes. For some ecological systems, however, threats and lack of protection may change this situation rapidly. Only two of our systems scored Effectively Conserved; 16 systems are in need of some level of conservation attention if they are to reach Effectively Conserved status (Table ES-1). This situation implies both great risks and great opportunities for conserving functioning landscapes in our state.

Shortgrass prairie is by far the most altered of any of Colorado's major ecological systems, has fair threat status, and is poorly protected as well. Despite the loss of nearly half of Colorado's shortgrass prairie in the past century, there remain some very large, high quality areas that present excellent opportunities for conservation.

Species

It is important to note that the majority of Colorado's plants and animals are not at risk (Figure ES-1). Of the species that are at risk, fish and amphibians – both aquatic dependent species – have the

Table ES-1. Overall conservation status scores for Colorado ecological systems analyzed.

System Name	Conservation Status
Alpine Tundra	Effectively conserved
Aspen	Moderately conserved
Foothill Shrubland	Weakly conserved
Grasslands	Weakly conserved
Greasewood	Under conserved
Juniper	Weakly conserved
Lodgepole Pine	Moderately conserved
Mixed Conifer	Moderately conserved
Oak & Mixed Mtn Shrub	Weakly conserved
Pinyon Juniper - CO PL	Weakly conserved
Pinyon Juniper - SRM	Moderately conserved
Ponderosa Pine	Weakly conserved
Sagebrush	Weakly conserved
Salt Shrub	Weakly conserved
Sand Sage	Under conserved
Shortgrass Prairie	Under conserved
Shrub-Steppe	Moderately conserved
Spruce Fir	Effectively conserved

highest percentage of at-risk taxa. Forty-three percent of all native fish species are at-risk, and of those, almost all are weakly or under-conserved. Amphibians fared only slightly better, with 41% of native species at risk; half are weakly or under-conserved. Mammals, birds, and reptiles are nearly equal with approximately 20% of the species at risk or 80% not at risk. In terms of absolute numbers, plants have the highest number of at-risk species (103). However, 96% of our native plant species are not at risk.

At-risk status does not translate directly into federal legal protection. Of all the at-risk species in our state, a much smaller

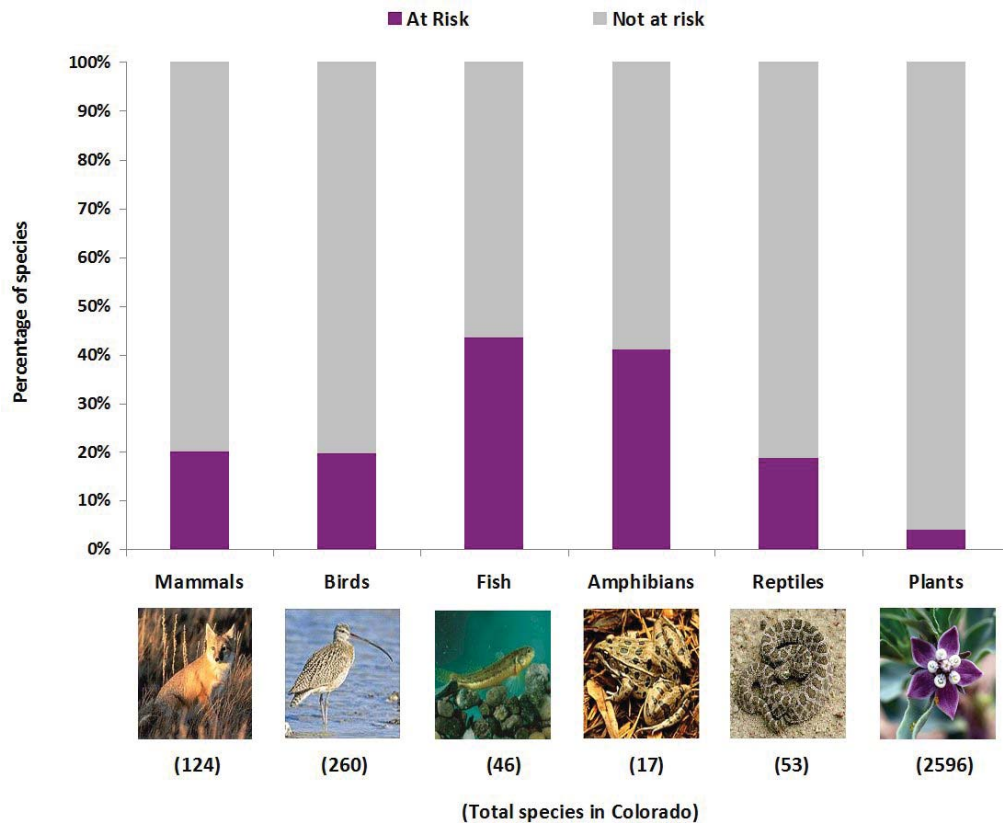
number are listed as threatened or endangered under the Endangered Species Act:

- Amphibians = 0
- Birds = 6
- Fish = 5
- Mammals = 4
- Reptiles = 0
- Plants = 16

Animals

Colorado has approximately 500 vertebrate species, of which approximately 20% are considered at-risk (Figure ES-1). Twelve native vertebrate species have been extirpated from Colorado. We evaluated 113 vertebrate species and found that 68 of these are “under”

Figure ES-1. Comparison of conservation status between taxonomic groups, statewide. Percentage-wise, fish and amphibians are most in need of conservation attention. However, in terms of total numbers of species, the plant group has by far the greatest number of at-risk species.



or “weakly conserved” and would greatly benefit from conservation action. The remaining 45 species are “moderately” to “effectively conserved” and although they would benefit from conservation action, the urgency is not as great. The following describes some of the results from each taxonomic group.

Fish

Prior to European settlement, we had 53 native fishes. Due to direct mortality, introduced species, and water development projects, we lost seven species (mostly from the eastern plains) and we are

struggling to maintain five species, all from the Colorado River Basin and federally listed. Almost half of Colorado’s extant fish are considered at-risk. Primary threats to our fish include introduced species and water development. Colorado now has more non-native (87) than native fish and most waterways have been manipulated.

Amphibians

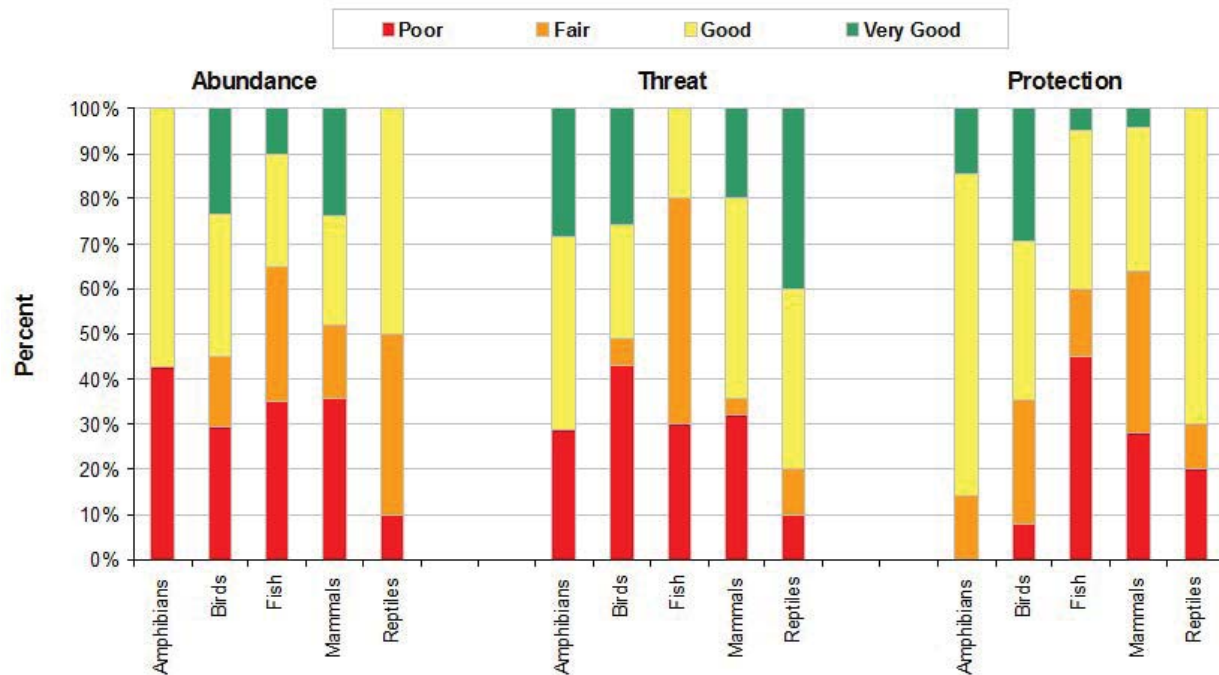
Of Colorado’s 17 native amphibians, almost half (41%) are at-risk, the second highest percentage of any group, following fish. Nearly 30% of these are highly threatened

while protection is good to very good for most species (Figure ES-2). These water-dependent species are threatened by disease and non-native species. The majority of these species are found in the eastern plains although the Rocky Mountains has one of the most imperiled species—the boreal toad, highly threatened from chytrid fungus yet adequately protected.

Mammals

Of the 124 native mammals in Colorado, 99 species (80%) have stable populations, and 25 species (20%) are at risk. Four mammals

Figure ES-2. Conservation status scores for vertebrate animal species by rating factor (abundance, threat, and protection) and taxonomic group.



are federally listed. Fifteen of the at-risk species are weakly or under conserved and are in need of threat abatement and/or protection (Figure ES-2). Nearly half of the at-risk species inhabit grasslands. The primary threats are direct mortality, and urban and energy development.

Birds

There are 240 native breeding bird species in Colorado, by far our largest vertebrate group. Thus it is no surprise that birds have the greatest number of at-risk species (51) among all animal groups. However, in terms of percentages, our native birds are comparable to the mammal and reptile groups, with 20% at risk. Six of Colorado's at-risk bird species are federally listed. The habitats

with the greatest number needing conservation action are grasslands, shrublands, and wetlands. Nearly 50% of the birds have poor threats while nearly 1/3 of them are under protected (Figure ES-2). The most significant threats are habitat loss due to conversion to cropland, forestry, energy development, and wetland/riparian alteration.

Reptiles

Of Colorado's 53 native reptiles, the majority (81%) have stable populations, while 19% are at risk. There are no federally listed reptiles. Eight of the 10 at-risk species are found in the Eastern Plains and grasslands and wetlands are important habitats. Some 20% of the reptiles are highly threatened while 30% are under protected

(Figure ES-2). Invasive species and energy development are the primary threats.

Only 15 of the 113 at-risk vertebrate animal species evaluated received an overall conservation status score of "Effectively Conserved," leaving 98 species (20% of all of Colorado's vertebrates) in need of conservation action (Figure ES-2).

In terms of the ratio of at-risk species to those not at risk, Colorado's aquatic-dependent fish and amphibians are in greatest need of conservation attention, with 44% and 41% of species at risk, respectively (Figure ES-1). Birds, mammals, and reptiles are in somewhat better condition overall, with 20%, 20, and 19% in need of conservation, respectively.

In actual numbers of species, rather than ratio of at-risk to not-at-risk, the bird group has the highest total number of species in need of conservation action, with 28 species receiving an Under Conserved or Weakly Conserved score.

Thirty-one percent of the vertebrate species we scored had very low abundance scores. Once again, fish are doing comparatively worse than other taxonomic groups. Nearly 35% of all of the scored vertebrates were rated highly threatened. The fish group has, by far, the highest proportion of species significantly threatened, with mammals and birds a distant second and third.

Forty-six percent of the scored species received poor scores in the Protection category. Species within the fish and mammal groups have the least protection, while amphibians are the most secure in terms of legal land protection.

Results by Habitat Type

For Colorado's at-risk vertebrates, wetlands (including aquatic habitats) and grassland habitats host the greatest number of our at-risk species. Though wetlands and aquatic areas occupy less than 2% of Colorado, the proportion of at-risk species that rely on them is very high, and the majority of these species are Weakly or Under Conserved. Grasslands occupy 22% of Colorado's landscape (the largest habitat type in Colorado yet it has the greatest loss), and our grassland species continue to decline. Table ES-2 provides a break down by habitat.

Table ES-2. Number of vertebrate species included in this analysis in each habitat.

Habitat	Number of Animal Species
wetlands/aquatics	46
grasslands	28
forests	13
shrublands	10
cliff and canyon	7
pinyon-juniper	7
alpine	1

Plants

There are approximately 2,600 plant species in Colorado. The Colorado Natural Heritage Program tracks over 500 regionally endemic or uncommon (rare) plant species (CNHP 2008). Of these, 253 are critically imperiled (G1), imperiled (G2), or vulnerable to extinction (G3) on a global scale. Sixteen of these G1, G2, and G3 species are federally listed as threatened or endangered. Of Colorado's 113 G1G2 plant species, 100 were included in this analysis, together with three G3 species.

Excluding species with a low percent of their range in Colorado, 51% of the rare species analyzed here are in the moderately or effectively conserved categories (Figure ES-3). Nearly half of Colorado's G1G2 plant species are poorly or weakly conserved, often due to significant threats and lack of protection.

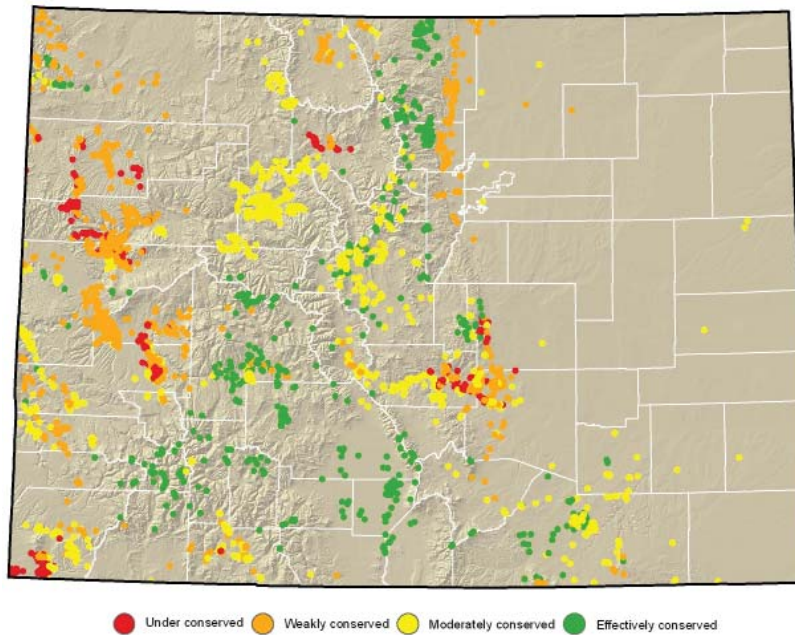
Biodiversity scores were generally low, largely because rare plant species typically have a small number of occurrences and occupy a small area within a limited range. Threat status for 45% of our rare plant species is poor to fair, especially for species occurring in barrens and shrubland habitats. In general, species of higher elevations are less threatened, while those occurring in the Colorado's western plateaus and valleys are most threatened.

Protection status scores for Colorado's rare plants are mixed. Overall, about half of the species, particularly those of higher elevations, have very good protection status scores. Poor protection scores are concentrated in the barrens, shrubland, pinyon-juniper, and wetland habitats.

Results by Habitat Type

Three habitat types accounted for about 60% of the plant species analyzed in our scorecard (Table

Figure ES-3. Distribution of at-risk plant occurrences by overall conservation status.



of Colorado’s rare plant species are at risk from resource extraction, motorized recreation, housing and urban development, and roads.

Although the results of our scorecard indicate that many of Colorado’s rare plants need more protection, the good news is that because many high quality occurrences are known to exist, there is still time for actions that will ensure effective conservation for these species.

Geographic Regions

Colorado can be divided into three primary geographic regions: Eastern Colorado Plains, Colorado Rocky Mountains, and Western Colorado Valleys and Plateaus.

The Eastern Colorado Plains have the highest number of at-risk animal species – 65, compared to Colorado Rocky Mountains (49) and Western Colorado Valleys (52) (Figure ES-4). The plains also have the highest proportion of its total fauna in some category of

ES-3). Of the 46 species with the poorest threat status scores, the majority (72%) are within the barrens and shrubland habitats. Barrens occupy less than 1% of Colorado acreage, but support more than 20% of the rarest species.

Shrublands are Colorado’s second most important habitat for rare plants, and are found on nearly 20% of the state’s acreage. The primary threats to Colorado’s rare plants are varied, but the greatest impact is likely to come from a few threat types. One third

Table ES3. Number of plant species and threat status scores by primary habitat. The approximate percentage of Colorado’s total acreage occupied by each habitat type is shown, together with the number of rare plant species primarily occurring in that habitat, and the number and percentage of those species having a high level of threat).

Habitat	% of Colorado Landscape	Number of Plant Species in Scorecard	Number of species in “most threatened” (red or orange) categories	Percent of plant species in “most threatened” (red or orange) categories
Barrens	< 1%	24	19	79%
Shrubland	19%	22	15	68%
Wetland	2%	8	3	38%
Pinyon-Juniper	10%	16	5	31%
Forest	21%	4	1	25%
Grassland	22%	4	1	25%
Alpine	3%	12	3	25%
Cliff and Canyon	< 1%	13	0	0%

conservation concern. The Eastern Colorado Plains is considered the most species-diverse region in Colorado for amphibians and reptiles, so it isn't surprising that the plains have more amphibians and reptiles of conservation concern than the other regions. Eighty percent of Colorado's native amphibians and reptiles occur in the eastern plains (Hammerson 1999), as do 45 % of our native fish. Fish distribution across geographic regions is relatively consistent, with 35 % in the Colorado Rocky Mountains and 25% in the Western Colorado Valleys and Plateaus. With regard to rare plant species, Colorado's Rocky Mountains and Western Valleys and Plateaus are rich with endemic plant species, many of which are of conservation

concern. While the Eastern Plains have very few rare plants.

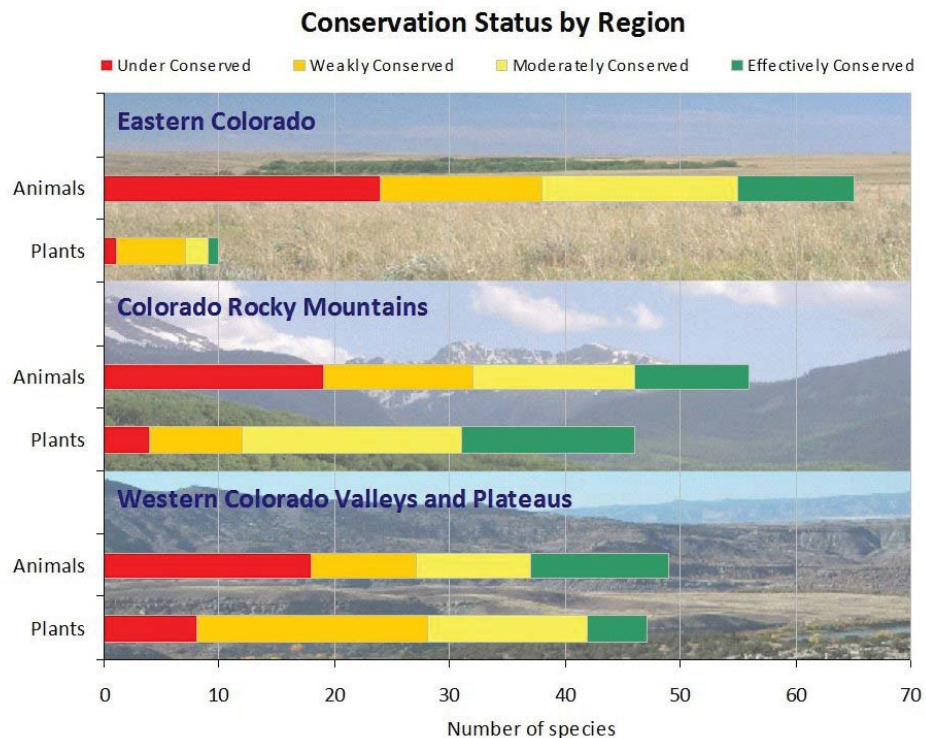
Conclusion

This report presents the current "state of the state" for Colorado's biodiversity, as well as a transparent and repeatable method of evaluating the success of future conservation action. Although the primary purpose of this document is to refocus and set new priorities for conservation efforts, the results also present a picture of work yet to be done that is daunting by any standard. While the numbers, graphs, and pictures demonstrate why we need to continue and improve our efforts, the reader

should also note the tremendous successes already achieved.

Without the contributions of many dedicated individuals, conservation groups and public agencies from the local to national level, Colorado's biodiversity – its species and ecosystems – would not be as rich as it is today. The decades-long efforts of all who are dedicated to conserving our biodiversity are apparent in the results of this scorecard. For example, the push to designate and conserve wilderness areas beginning half a century ago led to the high scores of high elevation ecosystems such as spruce-fir forest and alpine tundra. In species conservation, raptors, including the Bald Eagle and Peregrine Falcon, are a notable success story, thanks

Figure ES-4. Conservation status of at-risk animals and plants by region.



to ongoing efforts to change policies and preserve both individuals and their habitats. Furthermore, a number of our rarest plants have clearly benefited from local and regional conservation efforts, including the Larimer aletes in the Laramie Foothills, the slender spiderflower in the San Luis Valley, and a number of high elevation species that are primarily found in wild areas, such as the Colorado Buckwheat. These successes underscore the importance of holding ourselves, the conservation community, and the citizens of Colorado to a high standard. Our biodiversity is rich and loved by residents and visitors alike – it is the fabric that supports us in both good and bad times. Colorado has developed a strong conservation ethic and this report is an important map to guide our future efforts. The information in this report tells us how well we have done in the past, as well as pointing out where we need to redouble our efforts.

An important note regarding global climate change: this report contains the culmination of several years' worth of data analysis and synthesis. At the time that most of these analyses took place, data for predicting the impact(s) of climate change on biological resources were in the early stages of development, and methods were (and remain) under debate. Therefore, this significant potential threat is not directly addressed in this iteration of the Scorecard analysis for plants and animals, but is a high priority for the next iteration of this report.

The good news is that Colorado is blessed with a relatively intact natural landscape that still supports the majority of our native biological diversity. This means that we still have many options for conserving and protecting our at-risk species and ecological systems. Roughly 80% of our species are doing well, but 20% need help to survive. We hope that with continued conservation action we can improve the conservation status of that 20%. Wetlands and other aquatic habitats, grasslands, shrublands, and barren landscapes are high priority habitats for immediate conservation attention, including protection, restoration, and management. On-going maintenance of our forest and alpine systems is also needed, especially in the face of climate change.

The next step is to develop and implement the management, threat abatement, and protection strategies needed to decrease the number of at-risk species and improve their conservation status. We believe

that with good planning, education, and adequate funding, we can protect and manage Colorado's unique biodiversity features – but this will take a concerted effort on the part of scientists, conservation biologists, policy makers, and funders – not to mention the will of the people.

The information in this report should be valuable to those implementing these strategies. We recommend updating this Scorecard on an on-going basis, including a revised summary report issued every five to 10 years. This will allow the state to monitor trends in the conservation status of its species, habitats, and ecological systems over time. We hope our conservation partners will join with us in this effort. We welcome suggestions on how to improve this document for the next update, and hope that it will be used to help keep Colorado colorful!



Appendix H: Stakeholder Agencies and Organizations

Adams County Parks Department
Adams State College
Army - Pueblo Chemical Depot
Aspen Valley Land Trust
Audubon Colorado
Audubon Society of Greater Denver
Back Country Hunters
Betty Ford Alpine Gardens
BIO-Logic, Inc.
Black Canyon Regional Land Trust
Boulder County
Boulder County Audubon
Boulder County Nature Association
Boulder County Parks & Open Space
Bureau of Land Management
Bureau of Reclamation
City of Boulder Open Space and Mountain Parks
City of Fort Collins
City of Loveland
Clear Creek Land Conservancy
Colorado Natural Heritage Program
Colorado Beekeepers
Colorado Cattlemen's Agricultural Land Trust
Colorado Coalition of Land Trusts
Colorado College
Colorado Counties Inc.
Colorado Department of Agriculture
Colorado Department of Natural Resources
Colorado Department of Transportation
Colorado Field Ornithologists
Colorado Hawking Club
Colorado Headwaters Land Trust
Colorado Mountain Club
Colorado Native Plant Society
Colorado Natural Areas Program
Colorado Natural Heritage Program
Colorado Openlands
Colorado Outfitters Association
Colorado Pesticide Network
Colorado Sportsmen's Roundtable
Colorado Springs Utilities
Colorado State Forest Service
Colorado State Land Board
Mesa Land Trust
Montezuma Land Conservancy
Colorado State University
Colorado Trout Unlimited
Colorado Wildlife Federation
Colorado Wildlife Heritage Foundation
Community Mediation Concepts
Conservation Colorado
Continental Divide Land Trust
Crested Butte Land Trust
Defenders of Wildlife
Denver Botanic Gardens
Denver Museum of Nature and Science
Denver Zoo
U.S. Department of Defense
Douglas County Open Space
Douglas Land Conservancy
Duane Nelson
Ducks Unlimited
Eagle County Open Space Program
Eagle Valley Land Trust
Ecologic, LLC
ENSR Corporation
Environmental Defense
ERO Resources
Estes Valley Land Trust
Fort Collins Audubon Society
Fort Collins Natural Areas
Fort Lewis College
Friends of Colorado Natural Areas
Friends of Wolf Creek
Front Range Community College
Great Outdoors Colorado
Great Plains Landscape Conservation Cooperative
Gunnison County Wildlife Conservation Coordinator
Gunnison Ranchlands Conservation Legacy
Head First Biological, LLC
Intermountain West Joint Venture
Jefferson County Open Space
Jews of the Earth
La Plata Open Space Conservancy
Land Trust of the Upper Arkansas
Larimer County Parks and Open Lands
Legacy Land Trust
Lower Arkansas Valley Water Conservancy District
Sierra Club
South Metro Land Conservancy

Colorado's 2015 State Wildlife Action Plan

Mountain Area Land Trust	Southern Plains Land Trust
National Audubon Society/Tout Unlimited	Southern Rockies Landscape Conservation Cooperative
National Center for Genetic Resources Preservation	Southern Ute Tribe
National Park Service	Tetrattech
National Wildlife Federation	The Conservation Fund
Natural Resources Conservation Service	The Nature Conservancy
Natural Resources Defense Council	The Palmer Land Trust
NatureServe	The Wilderness Society
Nebraska	Trust for Public Land
North Central Climate Science Center	U.S. Fish and Wildlife Service
Orient Land Trust	U.S. Forest Service
Outdoor Heritage Consulting	U.S. Geological Service
Palmer Land Trust	U.S.D.A. Agricultural Research Service
Pheasants Forever	University of Colorado
Pitkin County Open Space & Trails	University of Northern Colorado
Playa Lakes Joint Venture	University of Wyoming
Prairie Dog Coalition	Urban Wildlife Rescue
Prairie Preservation Alliance	Ute Mountain Ute Tribe
Quiet Use Coalition	Western Conservation Foundation
Rio Grande Headwaters Land Trust	Western Resource Advocates
River Otter Alliance	Western Slope Conservation Center
Roaring Fork Conservancy	Western State College
Rocky Mountain Bighorn Society	Westwater Engineering
Rocky Mountain Bird Observatory	Wild Earth Guardians
Rocky Mountain Climate Organization	Wild Sheep Foundation
Rocky Mountain Elk Foundation	Wild Turkey Federation
Rocky Mountain Recreation Initiative	WildAgain Wildlife Rehabilitation, Inc.
Rocky Mountain Wild	Wilderness Land Trust
Roe Ecological Services	Wool Growers
San Isabel Land Protection Trust	Wyoming Natural Diversity Database
San Juan Citizens Alliance	Xcel Energy
San Miguel County Open Space & Recreation	Xerces Society
Sheep Mountain Alliance	Yampa Valley Land Trust

Appendix I: Stakeholder Comment Invitations

SGCN Comment Invitation

From: SWAP_Input, DNR_ [mailto:dnr_swap_input@state.co.us]

Sent: Thursday, July 03, 2014 11:36 AM

Subject: SWAP Revision Stakeholder Comments Welcome: Species of Greatest Conservation Need

Greetings, Friends of Colorado's Wildlife.

This message represents the first opportunity for stakeholder input into the revision of Colorado's State Wildlife Action Plan (SWAP). The SWAP is a required component of the federal State Wildlife Grant Program administered by the U.S. Fish and Wildlife Service. It is our 10-year vision for managing Colorado's fish, wildlife, and natural habitats, and is designed to guide our efforts toward:

- developing clear conservation goals,
- prioritizing conservation of rare and imperiled species,
- identifying important conservation opportunity areas,
- supporting conservation efforts that preclude the need to list species under the Endangered Species Act,
- keeping common species common, and
- engaging the public and partners in wildlife and habitat conservation.

Each state's SWAP must address these eight required elements:

1. Fish and wildlife species of greatest conservation need
2. Location and condition of key habitats
3. Threats and information needs
4. Priorities for conservation action
5. Plans for monitoring species, habitats, and effectiveness of conservation actions
6. Process for reviewing the SWAP every 10 years
7. Coordination with land management entities
8. Broad public participation.

This 10-year revision of Colorado's 2005 SWAP will be taking place over the next 12 months, with a final revised SWAP scheduled for delivery to the U.S. Fish and Wildlife

Service by September, 2015. As we update and revise each element of the SWAP, we will be inviting stakeholder input according to the calendar posted here:

<http://cpw.state.co.us/aboutus/Pages/StateWildlifeActionPlan.aspx>.

The attached document addresses required element 1: Species of Greatest Conservation Need. We seek input on the rosters of the Tier 1 and Tier 2 lists and associated justification for exclusion or inclusion, especially for taxa that may appear to be underrepresented in these lists (including invertebrates and other taxa for which we have limited information). **Please submit comments via email to dnr_swap_input@state.co.us by 5:00 p.m. on August 1, 2014.** Thank you for your interest in the conservation of Colorado's natural heritage!

Habitats Comment Invitation

From: **SWAP_Input, DNR_** <dnr_swap_input@state.co.us>

Date: Fri, Aug 22, 2014 at 3:23 PM

Subject: Colorado State Wildlife Action Plan Revision

Greetings, Friends of Colorado's Wildlife.

This message represents the second opportunity for stakeholder input into the revision of Colorado's State Wildlife Action Plan (SWAP).

The attached document addresses required element 2: Habitats. We seek input on the status and condition of Colorado's key habitats, as well as the list of SGCN associated with each. **Please submit comments via email to dnr_swap_input@state.co.us by 5:00 p.m. on September 19, 2014.** Thank you for your interest in the conservation of Colorado's natural heritage!

SWAP BACKGROUND [*this section repeated in all subsequent invitations*]

The SWAP is a required component of the federal State Wildlife Grant Program administered by the U.S. Fish and Wildlife Service. It is our 10-year vision for managing Colorado's fish, wildlife, and natural habitats, and is designed to guide our efforts toward:

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Threats and Conservation Actions Comment Invitation

From: **SWAP_Input, DNR_** <dnr_swap_input@state.co.us>

Date: Tue, Jan 6, 2015 at 2:09 PM

Subject: SWAP Review: Threats and Conservation Actions

Greetings, Friends of Colorado's Wildlife.

This message represents the third opportunity for stakeholder input into the revision of Colorado's State Wildlife Action Plan (SWAP).

The attached document addresses required Elements 3 and 4: Threats and Conservation Actions. This is the meat of the plan and we look forward to your comments and collaboration on this most important component of the SWAP. We seek input on the threats and necessary conservation actions for the species of greatest conservation need (SGCN) and the habitats upon which they rely.

The attached document "ThreatsActionschapter_stakeholderreview_January2014_entire" addresses vertebrate animals and mollusks. The second attachment, entitled "Invertebrates_threatsandactions_DRAFT" contains the threats and actions table for non-mollusk invertebrates. For Stakeholders with knowledge or expertise in invertebrate animals, we would greatly appreciate your comments on that table.

In addition, we have collaborated with USGS and the North Central Climate Science Center to undertake a climate change vulnerability assessment for the high priority habitats in the state and we offer the associated report for comment as well. It is included as Appendix B in the draft chapter that is attached.

Please share this email with others in your organization/contact list who may wish to contribute to this effort.

For any comments you have on Tables 4 and 5 in the attached chapter, or on the separate invertebrate table in the second attachment, please use the third attachment: "Template for comments" spreadsheet. For all other comments, please use either a Word document or simply submit your comments via email. Please refer to line numbers in your comments so that we can be certain that comments will be incorporated as appropriate.

Please submit comments via email to dnr_swap_input@state.co.us by 5:00 p.m. on February 16, 2015. Thank you for your interest in the conservation of Colorado's natural heritage!

Monitoring Comment Invitation

From: SWAP_Input, DNR_ [mailto:dnr_swap_input@state.co.us]
Sent: Thursday, April 02, 2015 12:31 PM
Subject: SWAP Review: Element 5 - Monitoring

Greetings, Friends of Colorado's Wildlife.

This message represents the fourth opportunity for stakeholder input into the revision of Colorado's State Wildlife Action Plan (SWAP). The attached document addresses required element 5: Monitoring.

We seek input primarily on the content of Table 1 and Appendix A. These are lists of CPW's current monitoring programs or efforts for each SGCN (vertebrates/mollusks and

arachnids/insects, respectively). If you or your agency/organization is conducting monitoring programs for any SGCN or habitat, please send pertinent information. **Please submit comments via email to dnr_swap_input@state.co.us by 5:00 p.m. on May 1, 2015.**

Final Draft SWAP Comment Invitation

From: **SWAP_Input, DNR_** <dnr_swap_input@state.co.us>
Date: Fri, Jun 12, 2015 at 5:02 PM
Subject: Final Comment Period for Colorado State Wildlife Action Plan

Colorado State Wildlife Action Plan Participants:

We have been working together over the past year to revise the State Wildlife Action Plan. We have addressed species of greatest conservation need, habitats, threats and conservation actions, monitoring and other issues relative to the conservation of many of Colorado's plant and wildlife species. Your efforts have been greatly appreciated and have resulted in a high quality revision of the original SWAP.

This message initiates the fifth and final opportunity for input into the revision of Colorado's State Wildlife Action Plan (SWAP). We do not anticipate major rewriting or restructuring of the plan during this final comment period, but do want to extend the opportunity for you to comment on important errors/fixes that you may find in this Final Draft.

The following component files are accessible for download at the SWAP Website (<http://cpw.state.co.us/aboutus/Pages/StateWildlifeActionPlan.aspx>):

- Executive Summary
- Wildlife SWAP, main document
- Appendices A - J, which includes the Rare Plant SWAP (Appendix A) and the Climate Change Vulnerability Assessment (Appendix F)

Comments should be made in a Word document referencing which document you are commenting on and relevant line numbers.

Please submit comments via email to dnr_swap_input@state.co.us by 5:00 p.m. on July 17th, 2015.

Appendix J: List of Acronyms

AFWA	Association of Fish and Wildlife Agencies	NRCS	Natural Resources Conservation Service
ATV	All Terrain Vehicle	NRDC	Natural Resources Defense Council
Bd	<i>Batrachochytrium dendrobatidis</i> (Chytrid fungus)	NVC	National Vegetation Classification
BL	Blue Lineage (Greenback Cutthroat Trout)	NWR	National Wildlife Refuge
CDWR	Colorado Division of Water Resources	PIF	Partners in Flight
CGSSC	Colorado Greater Sage-Grouse Steering Committee	PIT	Passive Integrated Transponder
CHAT	Crucial Habitat Assessment Tool	PMJM	Preble's Meadow Jumping Mouse
CNAP	Colorado Natural Areas Program	RGCTCT	Rio Grande Cutthroat Trout Conservation Team
CNHP	Colorado Natural Heritage Program	SAD	Sudden Aspen Decline
COGCC	Colorado Oil and Gas Conservation Commission	SGCN	Species of Greatest Conservation Need
COMaP	Colorado Ownership, Management, and Protection Database	SRMGSC	Subcommittee on Rocky Mountain Greater Sandhill Cranes
COPIF	Colorado Partners in Flight	SWAP	State Wildlife Action Plan
CPW	Colorado Parks and Wildlife	SWG	State Wildlife Grants
CRCT	Colorado River Cutthroat Trout	SWREGAP	Southwest Regional Gap Analysis Project
CRP	Conservation Reserve Program	TNC	The Nature Conservancy
CSFS	Colorado State Forest Service	UCREFRP	Upper Colorado River Endangered Fish Recovery Program
CSU	Colorado State University	USDOA	U.S. Department of Agriculture
ESA	Endangered Species Act	USDOJ	U.S. Department of Interior
GCT	Greenback Cutthroat Trout	USFS	U.S. Forest Service
GL	Green Lineage (Greenback Cutthroat Trout)	USFWS	U.S. Fish and Wildlife Service
HCPC	Historic Climax Plant Community	USGS	U.S. Geological Service
IDFG	Idaho Fish and Game	UWIN	Utah Wildlife in Need
MWCC	Montana Watershed Coordination Council	WCRP	Wildlife Conservation and Restoration Program
NAS	National Academy of Sciences	WD	Whirling Disease
NASRF	Native Aquatic Species Restoration Facility	WPBR	White Pine Blister Rust
NEPA	National Environmental Policy Act		
NMGFD	New Mexico Game and Fish Department		