Colorado Parks and Wildlife

COLORADO WEST SLOPE MOUNTAIN LION (*Puma concolor*) MANAGEMENT PLAN

Northwest and Southwest Regions

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Executive Summary

Colorado Parks and Wildlife's (CPW) aim for mountain lion management on the West Slope of Colorado is to preserve, protect, enhance and manage mountain lions for the use, benefit, and enjoyment of the state's citizens and visitors. CPW strives to ensure that mountain lions continue to exist in relatively stable numbers in western Colorado for current and future generations to enjoy through hunting, occasional observation, and for their scientific, ecological and aesthetic value. This mountain lion management plan provides the framework for how CPW will achieve this goal in the Northwest and Southwest CPW Administrative Regions and replaces all existing West Slope Data Analysis Unit (DAU) lion management plans.

This West Slope Mountain Lion Management Plan operates with the assertion that CPW's thirteen DAU plans in western Colorado, each written in 2004 to describe a single lion population, are too small in spatial scale to properly manage solitary, low-density, wide-ranging carnivores like mountain lions. In many cases, sample sizes of mountain lion mortality data have been too small to reduce uncertainty in management conclusions and have not effectively informed past DAU objectives. This plan increases the size of the management unit at which analysis and evaluation will occur to a more appropriate scale: the CPW Administrative Northwest and Southwest Regions. As under recent lion management, hunter harvest will continue to be allocated across groups of Game Management Units (GMUs), but the size of each of these groups will be increased.

This plan incorporates recent developments in mountain lion research that have been published in the peer-reviewed literature over the last 16 years. Many of these advancements are discussed in this document and some provide integral parts of the framework of this plan. The monitoring thresholds included in this plan are supported by a strong body of research and management citations. In addition, this plan outlines the process of annual review, evaluation, and adjustment to management.

Regional Objectives: The management objective in both Regions is to maintain a relatively ***stable*** mountain lion population. This replaces historic objectives in the thirteen individual DAUs, two of which are managed for suppression of the population. Allocating allowable harvest mortality across the Region provides local managers flexibility in distribution of harvest limits, while Regional thresholds ensure the maintenance of population stability at the larger scale.

Regional Annual Data Collection and Monitoring Thresholds

Two annual monitoring thresholds are established in this plan and will be evaluated independently for each West Slope Region:

1) ***Adult Female Harvest Composition Threshold:*** *Adult female composition in total harvest will not exceed 22% in any year in each Region, excluding the Glenwood Special Management Area*

2) ***Total Human-Caused Mortality****: The 3-year average of total human-caused mortality will not exceed 17% of the extrapolated abundance index from the resource selection function for each Region, excluding the Glenwood Special Management Area*

The following totals do not include the Glenwood Special Management Area

Northwest Region total human-caused mortality threshold: 269 lions
Southwest Region total human-caused mortality threshold: 284 lions

Proposed 2021-2022 Northwest Region harvest objective: 243
Proposed 2021-2022 Southwest Region harvest objective: 185

Historic 2018-2019 Northwest Region harvest limits: 317
Historic 2018-2019 Southwest Region harvest limits: 194

Annual evaluation of adult female harvest composition allows assessment of what the population trajectory might be based on the selective nature of hound hunting and the proportional abundance of each age/sex class on the landscape. Limiting adult female harvest also acts to protect the component of the population responsible for reproduction. Use of a total human-caused mortality threshold acknowledges the biological importance of other human-caused lion mortality factors beyond harvest and sets a ceiling for that maximum acceptable mortality that interacts with information derived from adult female composition evaluations.

By complementing different aspects of our understanding of mountain lion population performance in each Region, these monitoring thresholds are designed to interact and modulate each other during annual analysis. If either threshold is exceeded, this plan lays out clear and supportable steps that will be taken with harvest management to return the population trajectory to a stable one. Additionally, as part of the West Slope plan, CPW will begin the initiation of a mark-resight lion density monitoring program. Survey areas on the West Slope would be used to confirm and align observed lion densities with abundance index projections generated from Regional resource selection function output.

Exceptions to Monitoring Thresholds: Retaining viable mountain lion populations for future generations, like with any other big game species, does not require populations to exist at their maximum potential. In GMUs 43, 44, 45 and 444 near Glenwood Springs, human safety and social tolerance levels is a higher management priority than lion abundance. This is balanced with the overarching goal at the much larger Northwest Regional scale, of maintaining a stable lion population. Consequently, this plan establishes the Glenwood Special Management Area (SMA) with its own management objectives and where the Regional monitoring thresholds will not be applied. Evaluation of techniques and efficacy of reducing human-lion conflicts in the SMA will be conducted under an adaptive management framework.

Management Plan Public Involvement:

In developing this plan, CPW gathered input from the public in various ways. To inform elements of the plan specific to the Northwest and Southwest Regions, CPW held 12 public meetings on the West Slope as well as a virtual Facebook event designed for any interested member of the public that couldn't attend the in-person meetings. This draft plan was posted on the CPW webpage along with a comment link for 6 weeks to collect additional public input. Outreach was also conducted directly to impacted land management agencies, county commissions, Habitat Partnership Program committees and stakeholder groups interested in lion management.

Appendices to this plan should be referenced for comprehensive explanations on the following topics:

Appendix A: Mountain Lion Life History, Ecology and Monitoring

Appendix B: Mountain Lion Management History in Colorado and the West Slope

Appendix C: Mountain Lion Resource Selection Function model

Appendix D: Literature Cited and References

Appendix E: Mountain Lion Plan Public Process and Results

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West Slope Mountain Lion Management Plan Goal and Strategy

On the West Slope of Colorado, Colorado Parks and Wildlife's (CPW) aim for lion management is to preserve, protect, enhance, and manage mountain lions for the use, benefit, and enjoyment of the citizens of Colorado and its visitors. The broad goal laid forth in this plan by CPW in both the Northwest and Southwest Administrative Regions is to manage for relatively **stable mountain lion populations**, while allowing for management flexibility at smaller scales.

This plan puts forth a strategy to allow management flexibility at the harvest limit group scale while regulating lion mortality with thresholds designed to maintain stable lion numbers at the larger Regional geographic scale. At small scales, lions experience great variation in rates of abundance, survival, mortality, immigration, and emigration and therefore while management assumptions about those parameters are quite important, they can be inaccurate. At larger scales however, it is more likely that differences in initial population density assumptions result in relatively small changes in population growth rate, and uncertainty about dispersal may not be as influential (Robinson et al. 2015). A review of these and other aspects of lion biology and ecology is provided in Appendix A. With implementation of this plan, we will transition from the 13 historic lion Data Analysis Units (DAUs) on the West Slope to the CPW Administrative Regions (Southwest and Northwest) as the management unit of interest, analysis and reporting.

The need for this West Slope plan is demonstrated as follows:

- Larger management scales (such as Regions) are most relevant to lion biology and most appropriately support management inferences from mortality and composition data
- Significant advancements in geographic information systems (GIS) modeling, lion monitoring metrics, density estimation and population trajectory information have been published in the realm of peer-reviewed literature over the last 15 years, and need to be incorporated into current and future management
- Existing lion management plans are outdated as all but one West Slope lion DAU have plans over 15 years old and this plan will leverage updates into one plan
- Without updated West Slope lion management plans, managers setting annual harvest limits are challenged with aligning metrics and objectives in historic plans against concerns over various aspects of plans that many have deemed to have lost relevance

Lion Harvest Terminology, Regulations Process and Hunting Seasons

Harvest Limit Groups: The term to describe the pool or grouping of West Slope Game Management Units (GMUs) that are joined together under one harvest limit will be called a "harvest limit group". In the past, harvest limit groups have been as small as one GMU or up to 5 or 6 GMUs. Under this plan, the size of harvest limit groups will increase, as each group will include more GMUs than under past plans.

Regional Harvest Objectives and Harvest Limit: CPW will establish annual "Regional harvest objectives" for the Northwest and Southwest Regions independently. However, the term harvest objective makes less sense and could create confusion at the smaller harvest limit group scale. Therefore, at the harvest limit group scale, we will continue to use the term "harvest limit" to describe the distribution of the Regional harvest objective across smaller geographic areas of the Region on an annual basis. In this context, the sum of the harvest limits within each Region is equal to the Regional harvest objective. Regional summaries included later in this plan provide further discussion on specific recommendations for the first 3 years of the plan.

As with current lion regulations, the annual harvest limit accounting will begin on April 1 and ends on March 31 (license year). Only hunter harvest (lions associated with take on a lion license) will be counted and deducted from the harvest limit. During the Regional harvest objective and harvest limit setting process, wildlife managers consider the estimated amount of non-harvest mortality that contributes to total human-caused mortality. While Regional harvest limits and harvest limit group composition are reviewed annually, it is CPW's intent that both will be largely static for the first 3 years of this plan on the West Slope. An exception to this stability in harvest limits would be if management thresholds are exceeded and management action is needed. Maintaining these new lion harvest limits for periods of ≥3 years will allow sufficient time for any management efforts to yield results. For example, if efforts are applied to decrease lion abundance in a local zone, Anderson and Lindzey (2005) suggest that a 3-year period is necessary to detect results. Other studies suggest that a time period between 3 and 5 years is the minimum time for recovery of previously suppressed populations (Logan and Sweanor 2001, Anderson and Lindzey 2005, Stoner et al. 2006, Robinson and DeSimone 2011).

Annual Lion Regulations Process: This West Slope Lion Management Plan continues to follow CPW's current regulatory process and timeline. The annual regulatory cycle for mountain lions occurs in two stages. The first stage includes regulations related to season dates, open GMUs or harvest limit groups, method of take, and harvest reporting requirements. The second stage involves the establishment of annual harvest limits by harvest limit groups.

Mountain Lion Regulation Development Process for **Seasons, Method of Take, Other Provisions**:

- July-September: internal considerations, conceptual development, regional review meetings
- October: issues considered at internal regulation review meetings
- November: issues/draft regulations presented for consideration at the Parks and Wildlife Commission meeting
- December: regulation language modified pursuant to November meeting outcomes
- January: final adoption action by the Parks and Wildlife Commission

Mountain Lion Regulation Development Process for **Harvest Limits**:

- June-July: analysis of harvest and total mortality, adult female harvest composition and Glenwood SMA lion management objectives
- September-November: internal development of harvest limit recommendations, regional review meetings, harvest limits by harvest limit group considered at internal regulation review meetings
- January: final adoption action by the Parks and Wildlife Commission on harvest limits along with final approval of all other lion provisions
- February: publication of online mountain lion brochure

Every 5 years, CPW's big game season structure is re-evaluated. During this structural review process, public input is solicited, with three hearing stages that include issue identification and examination, drafting of regulations, and final structure and approval by the Parks and Wildlife Commission. The approved 2020-2024 big game season structure is compatible with all aspects of this West Slope Mountain Lion Management Plan.

***Lion Hunting Seasons*:** Currently, two distinct seasons occur during the April 1- March 31 license year. Both seasons will be maintained in this plan, but use of an April season won't initially be employed in either Region outside of the Glenwood Special Management Area. The two seasons have different purposes, but each will operate within the context of a harvest limit system.

1. **April Lion Season:** The season will run from April 1-30, annually. The use of dogs as a hunting aid is allowed. This is primarily an additional opportunity season in locations where harvest limits may not be routinely achieved during the regular season. If conflicts with other resource management issues are anticipated or if harvest opportunity is not compatible with other management considerations, then an April season will not be initiated. The utilization of an April season is determined annually for each harvest limit group.
2. **Regular Lion Season:** Begins the day after the close of 4th rifle deer and elk season through March 31, annually. The use of dogs as a hunting aid is allowed. The bulk of lion harvest is expected during this time and the majority of hunter days will occur in this season. Lion hunting opportunity is unlimited during each license year until harvest limits are reached in each harvest limit group, at which point that harvest limit group will be closed for the remainder of the license year.

***Methods of Take*:** The use of dogs shall be allowed as an aid to take lions as prescribed within the foregoing April and Regular seasons. The use of mouth-operated predator calls is allowed. Legal rifles, shotguns, crossbows, handguns, and archery weapons are allowed. Under specific circumstances, as outlined in the SW and NW Regional summary sections, electronic calls will be legal in certain harvest limit groups.

Regional Data Collection Scales and Monitoring Thresholds

Lions occupy large spatial scales in terms of home ranges and dispersal patterns. They regularly live, move, and disperse across previously used DAU boundaries, CPW Administrative Region boundaries and even state lines. Consequently, monitoring mortality and female composition at small scales is hampered by small sample sizes and large amounts of annual variation. As noted by Logan and Runge (2020), larger regions for puma management are more appropriate to the scale of puma movements and demographics. At the historic DAU scales on the West Slope, the difference between a few animals of different gender or age classes could alter harvest composition and conclusions about management trajectory in some units. For example, from 2016-2018, annual total lion mortality was less than 40 animals for 9 out of 13 previous West Slope DAUs. When samples of each individual DAU's harvest were divided among the four age/gender classes (adult female, subadult female, adult male, and subadult male) the composition of any one class often would be represented by only 4 or 5 individual lions, causing year to year compositional proportions to commonly vary by 20-30%. This amount of variation in harvest composition confounds data interpretation, making it difficult for wildlife managers to evaluate the effects of different harvest levels on mountain lion population trajectories at the previous DAU scale.

Many lion biologists across the West suggest managing lion populations with respect to source-sink dynamics (CMGWG 2005, Cooley et al. 2009*a*, Robinson and DeSimone 2011, Jenks et al. 2011, Logan 2019). Source areas are managed for the production of dispersers that move to other source areas and into sink areas where management objectives call for greater lion mortality. Thus, source areas retain a capacity for population resiliency region-wide. This approach allows for considerable flexibility in applying variable harvest rates spatially and temporally. This would be in contrast to a management framework with little flexibility where harvest is attempted to be apportioned evenly across the landscape as outlined by Beausoleil et al. (2013). The West Slope plan incorporates source-sink dynamics by allocating lion harvest mortality across the Northwest and Southwest Administrative Regions at a level appropriate for a stable population objective, while allowing harvest pressure to vary within more local areas defined by harvest limit groups.

West Slope Mule Deer Strategy and Lion Plan Relationship

Due to recent declines in mule deer populations across the West Slope, CPW embarked on a comprehensive public engagement and planning effort in 2014 to develop a West Slope Mule Deer Strategy to guide future management actions to help western deer herds increase towards objectives. The goal of the West Slope Mule Deer Strategy states that together with the public and stakeholders, CPW will work to stabilize, sustain and increase mule deer populations in western Colorado and, in turn, increase hunting and wildlife-related recreational opportunities. Relative to mountain lions, one of the seven strategies outlined in the Mule Deer Strategy is to implement lion reductions where predation has been shown to be limiting deer survival. This West Slope lion plan provides the flexibility, if needed, to allocate lion harvest at the harvest limit group scale within a Region to implement higher local harvest

rates consistent with the priorities of the Strategy, while still managing to the Regional objective.

Regional Data Analysis Units

The history of mountain lion management in Colorado, and more specifically on the West Slope, is provided in Appendix B. This appendix includes an overview of harvest management, methods of hunting, game damage, and a human-lion conflict discussion all within the historical DAU-specific management structure. A map showing the 13 historic mountain lion DAUs is also included in Appendix B.

Under this new plan, the West Slope will be comprised of two Data Analysis Units, corresponding to the CPW Northwest (NW DAU) and Southwest (SW DAU) Administrative Regional boundaries instead of the historic DAU scale (Figure 1). The Northwest (NW) Region lion DAU is comprised of the previous lion DAUs of L-1, L-2, L-3, L-5, L-6, L-7 along with GMU 40 (previously in L-22) and GMUs 41, 42 and 421 (previously in L-9). The Southwest (SW) Region lion DAU is comprised of the previous lion DAUs of L-20, L-21, L-23, L-24, L-25 along with GMUs 52, 53, 63, 411 and 521 (previously in L-9), GMUs 60, 61, 62, 64, 65 (previously in L-22), GMU 82 (previously in L-16) and GMU 83 (previously in L-19).

The 13 historic DAUs have existing management plans that were written in 2004, with the exception of L-3, which was originally written in 2004 but amended in 2012. Eleven of the 13 plans have DAU population objectives of maintaining a “stable” lion population. Two of the plans, DAUs L-7 (White River) and L-9 (Grand Mesa/ North Fork), have “suppression” objectives that were largely implemented to reduce lion populations due to high rates of game damage (livestock depredation). The new NW and SW Regional management objectives will replace all historic DAU objectives in the areas governed by those 13 historic plans.

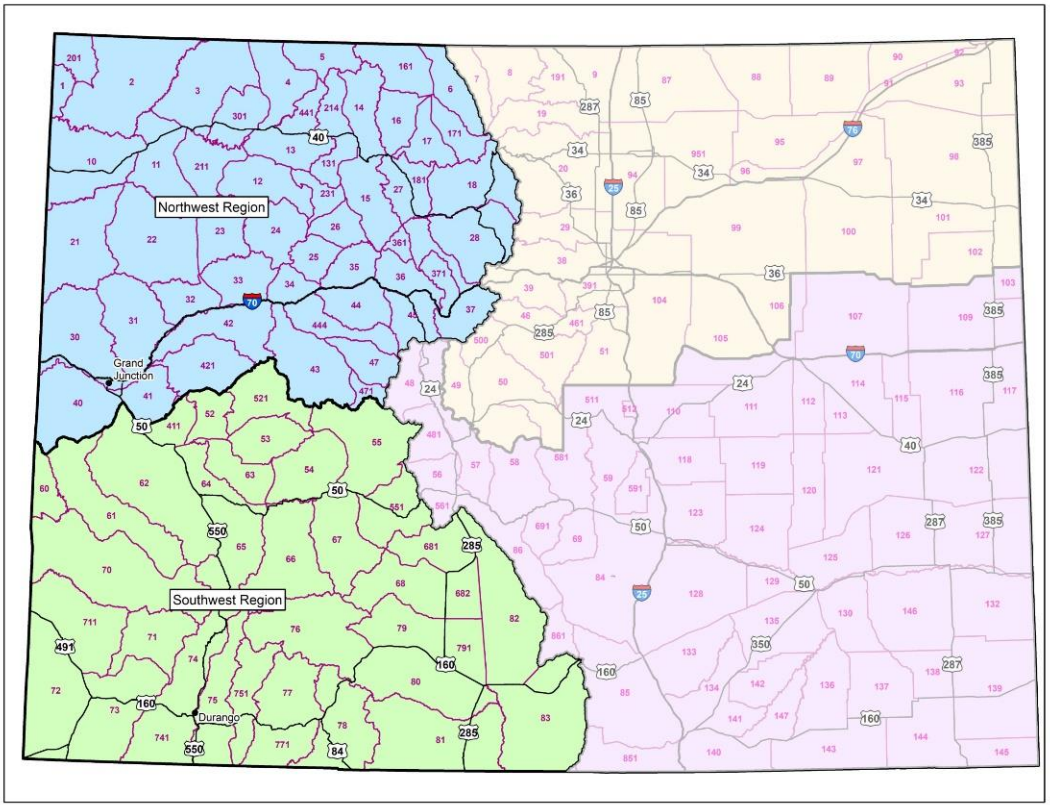

Figure 1. The location of the two West Slope Regional monitoring areas within Colorado.

Annual Data Collection

All known lion mortalities in Colorado are recorded during a mandatory check process. In the case of harvest mortalities, every hunter is required to report their harvest within 48 hours and present the hide and head for inspection within 5 days. During this mandatory check, biological data is collected including sex, evidence of past nursing/breeding status, and age information, including extraction of a premolar for cementum aging (Table 1).

Table 1. Cementum (premolar tooth) aging guidelines

Cementum Age	Age Class
0-12 months	Kitten
1 year or 2 years old	Subadult
3 years and older	Adult
Female of any age that shows evidence of past nursing	Adult

Lion mortality data are used to evaluate age and sex composition of harvest, distribution of harvest and non-harvest lion mortalities, indices of population trajectory, and to account for and set harvest limits. Due to standard time delays in cementum analysis, the current harvest composition analysis is always retrospective information, lagging one harvest year behind regulatory cycles.

Harvest data can be used in many different ways. The age of reproductive females can be useful to examine the reproductive potential of lion populations (Stoner 2004, Anderson and Lindzey 2005). Populations maintaining older-age females have higher reproductive potential, and thus resiliency, than populations where adult female survival is lower. Additionally, recording the distribution of lion harvest and other human-caused mortalities allows assessment of potential source areas where little or no lion mortality occurs, and sink areas where lion mortalities may be relatively high. This kind of spatial analysis may be used to help inform harvest limits that are established by harvest limit groups.

As recommended by Beausoleil (2017), we approached all demographic metrics referenced in this management plan with standardization in mind. Since most recent literature focuses on metrics defined by "independent" lions, that is the common standard we have used in all data, thresholds, and models presented in this plan. Independent lions are defined as animals that are not dependent on their mother; this includes subadult lions and adult lions. See Appendix A for details on mountain lion life history. Kittens are considered dependent lions, and as such are not legal for harvest and are not included in demographic metrics and thresholds.

Adult Female Composition Threshold

Both the survival rate and relative abundance of adult female lions, as the reproductive component of a population, are important considerations for managers. For instance, in the Garnet Mountains of Montana during an un-hunted period, 71% of the growth rate in the population was related to reproduction (maternity and kitten survival), while adult female survival accounted for only 22% of the population growth rate. When hunting was added, only 17% of the growth rate in the population was related to reproduction, while adult female survival became more influential and accounted for 40% of the population growth rate. Monitoring and population modeling efforts in this population indicated that when accounting for all forms of known human-caused mortality, adult female annual survival needs to be at least 80% to prevent a decrease in the resident lion population level (Robinson and DeSimone 2011) and therefore limits on adult female harvest mortality would be needed to prevent declines.

Recent research findings are presented below reviewing adult female harvest composition and population trajectory.

Wildlife managers, through the use of hunting harvest, have the ability to limit lion population growth (Robinson and DeSimone 2011). On the Uncompahgre Plateau, Colorado, during the 5-year lion hunting phase of a research project, ***adult females*** comprised 23% of the total cumulative harvest. In this study, lion harvest was considered additive mortality and lion survival rates and independent lion abundance declined when compared to the preceding reference phase with no lion hunting (Logan 2015, Logan and Runge 2020).

In southern Idaho and northern Utah, Laundre et al. (2007) tested the effects of changes in prey abundance on lion population dynamics. Through their monitoring of the change in population size and social-age class structure, they suggest that an annual harvest of 15 to 20% of ***resident (adult) females*** would not reduce a population.

Anderson and Lindzey (2005) conducted an experimental population reduction and recovery in the Snowy Range of Wyoming to examine how various gender and age classes are exposed in hunter harvest when a population is increasingly exploited. Because of the differences in daily movement distances it was assumed that under equal gender ratios, males are more vulnerable to hound hunting, which relies on discovery of tracks in snow. Increasing hunting pressure exposes different genders and age classes until they are relatively less available, subsequently exposing the next most vulnerable age class. Sex and age classes of lions exhibit different and relatively predictable movement patterns, where males move longer distances than females and subadults generally move longer distances than adults (Barnhurst 1986, Anderson 2003). Conceptually, the likelihood of a specific sex or age class of lion being harvested would reflect its relative abundance in the population and its relative vulnerability based on daily movement patterns. The least vulnerable individuals (adult females) should become prominent in the harvest only after the population has been reduced in size by removal of more vulnerable/available lions. Harvest progression of a higher density population would be expected to shift from subadults to adult males and finally to adult females as more vulnerable or targeted individuals are removed and the population is reduced in size (Anderson and Lindzey 2005). Selectivity in harvest where hunters select males over females or perhaps subadults is possible from experienced hunters using hounds by examining track characteristics or live animals prior to harvest. Selective harvests may delay or change the order of expected harvest progression, but this relationship should still hold as larger males are removed and the least vulnerable and most biologically important compositional class (adult females) becomes exposed as abundance of other more selected age/sex classes decline. Anderson and Lindzey (2005) tested these predictions by applying varying levels of hunter harvest and found harvest composition to be predominantly subadults for a high-density population with low harvest levels, shifting to adult males as harvest levels increased, and then a shift from adult males to adult females with continued high harvest as the population declined. Likewise, Cooley et al. (2009*b*) noted that adult females increased in harvest composition when hunting increasingly removed other age/sex classes in a population. When harvest levels were reduced, the composition of the harvest returned to primarily subadults. The male segment of the reduced population recovered within 2 years, primarily due to male immigration from other populations and the female segment within 3 years from an increased number of females producing young within the population (Anderson and Lindzey 2005). They concluded that the population appeared to support a harvest composed of 10-15% adult females. When ***adult female*** composition in hunter harvest reached approximately 25%, the population declined.

The results of these studies suggesting that setting Regional composition thresholds of between 20-25% adult females in hunter harvest will maintain the Region goals of managing

for a stable population. A threshold of 22% adult female harvest composition was selected because it represents a mid-range value based on these independent research efforts. Using cementum data and breeding status to classify adult females, we can infer that if our threshold is exceeded, the population in question would likely begin a decline. Because the goal is to not exceed this threshold and risk moving into a decline phase, adult female harvest composition will be examined annually and management actions will be enacted to reduce female and/or overall harvest if this threshold is exceeded in any single year.

Applying our new Regional monitoring scales to historic data, the composition of adult females in total harvest over the last 6 years has ranged from 9-20% in the NW Region and 14-18% in the SW Region (Table 2). These statistics suggest that even under increasing harvest levels over this period, neither Regional population has undergone a decline. In accordance with this plan, data will be evaluated annually to inform Regional management, but voluntary female and overall harvest reduction steps will be required only if the monitoring threshold of 22% is exceeded. The Glenwood SMA, described in greater detail in the NW Summary section, is the only area excluded from the annual harvest composition analysis in either Region.

Table 2. Northwest and Southwest Regional adult female harvest composition and sample size of interpreted age class (*N*) for the last 6 years (2013-2018). Data include all legal harvest mortalities for lions of known sex/age for all GMUs in each region.

		2013	2014	2015	2016	2017	2018
Northwest Region	Adult Female Composition in Total Harvest	20%	9%	16%	17%	19%	17%
	N	*172*	*163*	*172*	*201*	*203*	*205*
Southwest Region	Adult Female Composition in Total Harvest	14%	14%	18%	17%	16%	16%
	N	*107*	*118*	*115*	*141*	*125*	*131*

It should also be noted that less selective methods of harvest are likely to result in harvest composition that reflects the relative abundance of the 4 age-gender classes. Consequently, significant use of non-selective methods at any broad scale will confound harvest composition analysis. Hound harvest relies on a portion of hunters selecting against taking females based on track size or identification while bayed, but non-selective methods take lions of each compositional class in the same relative abundance that they are encountered, so much higher rates of female harvest would be expected. Because of this, we conclude that any other season or method of take besides hound hunting, such as electronic calls, that is largely non-selective of age-gender classes should be reserved only for areas where substantially increased harvest and population impact is desired. This would include the Glenwood SMA or areas where control removals are high but hound hunter harvest has not been successful due to limited snow. Non-selective hunting methods have been shown in Oregon and Washington to have higher female harvest rates when compared to hound hunting. A further discussion on these implications is presented in the “Methods of mountain lion hunting” section in Appendix

B, but electronic calls, as a non-selective method of harvest, would only be allowed in the areas prescribed in this plan.

Total Human-Caused Mortality Threshold

Clarification of terminology is an important precursor to the discussion of the total human-caused mortality threshold. Natural forms of mortality (drowning, starvation, disease, intraspecific strife, injury etc.) are sometimes documented by our mandatory check system, but such natural mortality will not be included in the total human-caused mortality analysis. The primary human-caused mortality factors includes hunter harvest, removal of depredating lions by CPW, landowner, and federal Animal and Plant Health Inspections Service/Wildlife Services agents (APHIS/WS), and lions killed by vehicles. The only exception of human-caused mortality sources that is not included in the mortality analysis is for lions that are killed because they are determined to be dangerous lions pursuant to CPW Administrative Directive W-20. Our reasoning for not including these kills in our calculations related to mortality thresholds is that regardless of lion population trajectory or any other management condition, CPW as a matter of policy would always take lethal action on lions that are determined to be a threat to public safety. Therefore, including them in calculations of total mortality thresholds is irrelevant. Additionally, the number of lions that are killed because they are determined to be dangerous is typically a very small number. For example, from 2016-2018 less than 10 lions annually were reported killed statewide as a result of having attacked or exhibited threatening behavior towards people. Lions removed in accordance with Administrative Directive W-20 are specifically documented as such to ensure conflict lion mortalities with this classification are clearly enumerated, as they will be excluded from analysis in all mortality totals.

Comparing the rate of population growth against population reduction from harvest can give managers information on what mortality levels would maintain a stable population. Recent research findings are presented below that helped inform CPW's total human-caused mortality threshold.

The growth rate for a population, or intrinsic rate of population growth, can be described as the rate biologists expect a population to grow in the absence of additive human-caused mortality. In Washington, the intrinsic growth rate for 3 different lion populations (Selkirk Mountains, Kettle Falls, and Cle Elum) was ***14%*** (+-2%) (Beausoleil et al. 2013). In Montana, the expected intrinsic growth rate of a modeled population through 2 years was ***15%*** when the results from a protected area and an adjacent hunted area were combined (Robinson and DiSimone 2011). Laundre et al. (2007) observed a lion population increase ***7%*** during a growth phase that correlated with an increasing deer population on the border of Idaho and Utah. In New Mexico, Logan and Sweanor (2001) observed population growth rates of ***5% and 17%*** for two 4-year periods, averaging ***11%*** for the entire 7-year period for a lion population segment protected from hunting. Furthermore, Logan and Sweanor observed higher growth rates of ***21% to 28%*** for an experimentally manipulated population segment that was substantially reduced in abundance and then protected to allow it to increase. Their research indicates

that lion population growth rates are highly variable and most likely density dependent (Logan and Sweanor 2001).

Examined differently in Wyoming, experimental control and recovery of a population determined that a harvest rate of ***18%*** of independent lions allowed recovery of the population that had been intensively harvested in two previous years (Anderson and Lindzey, 2005). On the Uncompahgre Plateau in Colorado, a lion population that was protected from hunting for five years and subsequently subjected to regulated hunting for five years yielded evidence that the marked lion population grew during the non-hunting period when total human-caused annual mortality was 7% or less and began to decline when total human-caused annual mortality was 27% and continued to decline at rates of 24-29% (Logan and Runge 2020). The discrete threshold at which population decline began could not be measured. The authors do note that inference should be made to population-scale harvest and human-caused mortality rates, as rates observed at a smaller scale are biased and represent underestimates (Logan and Runge 2020).

Although growth rates and mortality or harvest rates in expanding populations may act as surrogates for determining maximum sustained yield (the highest sustainable annual rate of removal), caution should be applied in this comparison. Stochastic events can change the assumed population size and may result in over-harvest, and thus are falsely assumed to be supported over the longer term (Caughley and Sinclair 1994).

Whether one looks specifically at Colorado data or examines the span of the 6 reported population growth rates and 3 reported mortality thresholds, a 16-17% annual total mortality rate is an appropriate range to manage for population stability. Therefore, this plan will use a maximum human-caused mortality threshold of 17% of Colorado's projection of possible lion abundance. This extrapolated lion abundance index is based on a resource selection function (RSF) model that was applied to each Region to generate an initial representation of how many lions could be in the population and the corresponding maximum mortality threshold (Table 3).

For more information about the abundance index extrapolation and the supporting RSF model as applied to the NW and SW Regions, see Appendix C. The RSF model developed for Colorado's lion population provides a probability of lion presence across areas of each Region and allows application of various densities to those probability classes to generate a projection of possible lion abundance. The RSF extrapolation that is generated is not a representation of actual lion population size, but rather the relative probability of resource selection by a lion population. It provides a method to derive a maximum mortality threshold at a given scale, which if exceeded, would lead to the reasonable conclusion that lion populations are experiencing a declining trend. The numerical value that is derived as a threshold from this analysis will not be exceeded on a 3-year running average in either Region. While not necessarily a management target, the total mortality threshold represents the maximum acceptable amount of annual human-caused mortality in each Region.

Table 3. Regional total human-caused mortality thresholds in relation to 2016-2018 total human-caused mortality data. The Regional mortality threshold for the NW Region does not include lion population or mortality contributions from the Glenwood Special Management Area (GMUs 43, 44, 45, 444). Historic mortality data for the SMA is provided on a separate line.

Monitoring Area	17% Annual Total Human-Caused Mortality Threshold	2016 Total Human-Caused Mortality	2017 Total Human-Caused Mortality	2018 Total Human-Caused Mortality	3-year Total Human-Caused Mortality Average
Northwest Region	269	228	232	245	235
Glenwood SMA	*NA*	27	11	22	20
Southwest Region	284	180	168	184	177

The total mortality thresholds in Table 3 may or may not change over the lifespan of this West Slope Mountain Lion Management Plan. Thresholds may change during the course of revisions based upon new scientific evidence, density estimates that refine the RSF, or related updates that may occur during periodic plan review. Colorado Parks and Wildlife will prioritize lion density estimation in future work planning to allow validation and refinement of densities applied to the RSF. The Glenwood SMA, which is described in greater detail in the Northwest Region Summary section, will be the only area excluded from annual threshold requirements in either Region. More specific historic data on harvest and non-harvest mortality is available in the Regional Summary sections of this document and in Appendix B; History of Mountain Lion Management in Colorado.

Adjustments to this human-caused mortality threshold is informed by the adult female compositional threshold. Direction of population trajectory as indicated by annual compositional evaluation provides a feedback mechanism to modify the common currency of human-caused lion mortality, which are harvest limits.

Annual Management Thresholds

The West Slope Lion Management Plan initiates a new management framework that evaluates annual lion mortality data against selected thresholds that are scientifically supportive of a stable lion population. The NW and SW Administrative Regions will be independently managed, and the Glenwood Special Management Area is excluded from evaluation against the NW thresholds. The two following mortality monitoring thresholds will be evaluated in an interactive manner.

1. Proportion of adult female (cementum age of 3 years or older, or any age with evidence of nursing) composition of total hunter harvest will not exceed 22% in any single year.

2. Total human-caused mortality will not exceed 17% of the extrapolated abundance index (see RSF in Appendix C and Table 3) based on a 3-year running average.

The adult female harvest composition threshold and total human-caused mortality threshold are intended to interact and inform each other. Therefore, if either threshold is exceeded, a management response to reduce mortality will be required and implemented in Regional harvest objective setting the following year.
If the 22% adult female threshold is exceeded in any single year (suggesting a decline in the population) the following actions will be taken:

- Regional harvest objective (and mortality threshold) used in that year will be reduced by 1% of the extrapolated abundance index. This represents a decrease from 17% to 16% of the RSF and would create a lower harvest rate and lower mortality threshold.
- CPW will also enact a voluntary female harvest reduction outreach process that includes:
    i. Publishing a request for hunters to voluntarily reduce female harvest in the CPW Mountain Lion Hunting brochure
    ii. Notifying hunters using the online Available Harvest Limit Report to identify harvest limit groups where CPW is voluntarily asking for reductions in female harvest
    iii. Contacting lion hunters directly to inform them of the voluntary request

If the total human-caused mortality threshold is exceeded or the 22% compositional threshold continues to be exceeded past one year, then a 5% reduction of the Regional harvest objective (and mortality threshold) will be implemented the following year. The human-caused mortality threshold continues to be independent of the female composition threshold.

Each time a reduction in Regional harvest objective is triggered by exceeding thresholds, the broad intention is that this reduction will be maintained using the recalculated Regional harvest objective for a minimum of 3 years. In some cases, if the annual female composition or 3-year average total mortality return to levels below the thresholds before that time, increases in Regional harvest objectives may be considered.

Annual Regional harvest objectives, outlined further in the West Slope Regional Summaries section of this plan, incorporate non-harvest mortality rates in development of acceptable harvest mortality levels so as not to exceed the total human-caused mortality threshold. As such, Regional harvest objectives will always be lower than total human-caused mortality thresholds and will likely fall in or near the annual harvest range of 12-16%, bracketing the 14% harvest off-take level as recommended by Beausoleil et al. (2013).

Voluntary Female Harvest Reduction Outreach

If the adult female composition threshold of 22% is exceeded, the first action should be to reduce adult female harvest. While differentiating subadult females from adult females before

harvest may be difficult, Colorado's lion hunters have a proven track record of being able to decrease harvest pressure on females when requested by CPW.

From 2005-2007, CPW, in collaboration with hound hunting groups, conducted training workshops about the biology and life history of mountain lion as well as the importance of females to sustaining populations. The lion regulation brochure also provided similar written information. In the 2007-2008 lion season, CPW implemented a mandatory mountain lion hunter education requirement. This course provides training information to hunters about mountain lion ecology and hunters must pass an exam demonstrating the ability to identify lion gender characteristics. Subsequently, the average total female composition in harvest declined from about 44% in the 10 years before 2005 to about 37% in the 14 years since. It is important to note this was a reduction in all female age classes, not just adults. As part of this West Slope plan, CPW intends to engage with lion hunters via the brochure, the online harvest limit report, and make informal field contacts to request voluntary reductions in female harvest if and when Regional annual adult female composition exceeds the 22% threshold. It would not be practical to ask for reductions just in adult females since age class determination in the field is much more challenging than gender determination. This outreach would likely decrease overall female harvest (all ages), but adult females would be part of that reduction, and we expect this to move composition trajectory in the desired direction.

Harvest Limit Reductions

Harvest limit reductions of 5% will be applied to the Regional harvest objective total in the regulatory cycle immediately following management thresholds being exceeded, as outlined above. Any such reduction in Regional harvest objective due to exceeding either threshold, outside of the Glenwood SMA, is mandatory and is a reduction minimum. Each time a reduction is applied to the Regional harvest objective, it will generally be maintained for 3 years. There may be cases where the 3-year total mortality or annual adult female compositional proportion returns below the management threshold before that time where increases in Regional harvest objectives will be considered. Nothing precludes managers from implementing larger reductions of Regional harvest objectives and harvest limits that are determined desirable or necessary to accelerate the lion population response.

The management steps CPW will take are based on empirical data in previously observed populations and on models developed in Colorado. The following section presents an evaluation quantifying Regional areas of minimal lion mortality and outlining the extent of source areas (Figure 2) and large-scale lion resiliency to harvest. Further, the application of monitoring thresholds is appropriate to guard against longer term impacts to populations on the West Slope and ensure population stability at that scale.

Lion Population Resiliency

Resiliency to High Mortality

Upon reaching age of independence, mountain lions disperse to maximize genetic interchange, which also serve to make populations resilient against high exploitation or rates of removal as vacated ranges are continuously being re-occupied by immigrants. Natural replacement of mortalities or otherwise vacated home ranges occurs differently between male and female lions. Vacated ranges of resident females are typically re-occupied by their independent-age daughters, adjacent resident females, and some immigrant females (Laing and Lindzey 1993, Logan and Sweanor 2001). In contrast, male dispersal from natal areas appears to occur regardless of resident adult male densities (Hemker et al. 1984). Consequently, vacated ranges of resident males are typically re-occupied by immigrant males, some coming from long distances. Logan and Sweanor (2001) documented this in New Mexico and numerous studies have recorded the long distances moved by dispersing lions as well as the sex bias in dispersal distance (Anderson et al. 1992, Ken Logan, CPW, personal communication 2018).

Source Population Refuges

In several studies, lion populations subjected to temporary intensive exploitation by > 40% over 1 to 6 year periods have been demonstrated to recover within 3 to 5 years (Ashman 1976, Logan and Sweanor 2001, Anderson and Lindzey 2005, Robinson et al. 2008, Logan 2015). In two such studies, the lion populations were completely protected from hunting (Logan and Sweanor 2001, Logan 2015). It is also important to understand that in addition to reductions in human-caused mortality, recovery was facilitated by immigrants coming from proximal source areas (Logan and Sweanor 2001, Anderson and Lindzey 2005, Robinson et al. 2008, Cooley et al. 2011). These results confirm that with adequate source populations in sufficient proximity to provide dispersal immigration combined with native recruitment, lion populations can be resilient when localized harvest rates exceed recruitment (Anderson and Lindzey 2005, Robinson et al. 2008, Cooley et al. 2009*a*, Cooley et al. 2011). These observations about lion resiliency and ability to rely on adjacent source populations are derived from research areas that range in size from the average GMU in Colorado (~1,500 km^2) to the largest GMU at about 7,500 km^2. The management thresholds of this plan will be monitored at a large, regional scale; therefore, if the thresholds are exceeded and are unmitigated, then longer-lasting negative impacts to the lion population should be expected. At this scale, male immigration is likely to be capable of re-occupying vacant habitat. In contrast, female immigration would likely occur initially along the boundary with adjacent Regions or adjacent states if intensive lion mortality is not also occurring in those locations. Some amount of female immigration may occur also from refuge areas within Regions (i.e., areas of high quality lion habitat with limited harvest as a result of land ownership or other restrictions of access), but this alone may not be sufficient to support continued mortality in excess of sustainable levels.

The following map of Colorado's West Slope (Figure 2) shows what could be considered refuge zones or source areas where lion harvest is low to non-existent. Using the same RSF (Appendix C) habitat model employed within this document in developing Regional total mortality thresholds, we compared the top 50% of lion habitat in the NW and SW Regions to the most recent 10 years of lion harvest mortality. All lion harvest mortalities from 2009-2018 were mapped and a mortality surface was created using ArcGIS, delineating a surface with more than 3 harvest mortalities per 1,000 km^2 per year. Areas of the West Slope that fell below this threshold were considered as having no significant level of harvest (0-3 harvested lions/1,000km^2/year)(Table 3). For comparison, Wyoming's statewide management plan considers a "source" hunt area to have an annual human-caused mortality level of below 5 lions/1,000 km^2, and defines a "stable" hunt area as having annual human-caused mortality between 5-8 lions/1,000 km^2(Wyoming Game and Fish Department, 2006). As shown in Figure 2 and Table 4, only a small fraction of lion habitat on the West Slope exceeds an annual harvest of 8 lions/1,000 km^2. In fact, less than 15% of the high-quality habitat in the NW Region and only 1% of the high-quality habitat in the SW Region meet the qualification that Wyoming uses to classify a population "sink" (>8 lions/1,000 km^2/year). Even if this analysis expands to consider all mortality sources beyond harvest, the proportions in each classification do not change significantly.

The 46,844 km^2 of higher quality lion habitat as generated from the top two strata in the RSF, was overlayed with a harvest mortality surface to evaluate the total amount of quality lion habitat on the West Slope of Colorado where no significant lion harvest occurs. The area of quality habitat with modeled moderate to higher lion densities and yet a low or non-existent level of harvest totaled 22,850 km^2 or over 5.6 million acres across the NW and SW Regions (Figure 2 and Table 4). This includes high-quality habitat within National Parks and Monuments, Bureau of Land Management Wilderness areas, protected municipality open spaces and natural areas, areas with little significant snowfall making lion harvest difficult, and large tracts of unhunted private land.

Table 4. Comparison of high quality lion habitat in each Region and harvest density.

	Total Area	Total High Quality Lion Habitat	Total High Quality Habitat with ≤ 3 harvested lions/1000 km^2/year "source zone"	Total High Quality Habitat with >8 harvested lions/1000 km^2/year "sink zone"
Northwest Region:	58,910 km^2	24,234 km^2	9,265 km^2	3,576 km^2
Southwest Region:	64,678 km^2	22,610 km^2	13,585 km^2	261 km^2

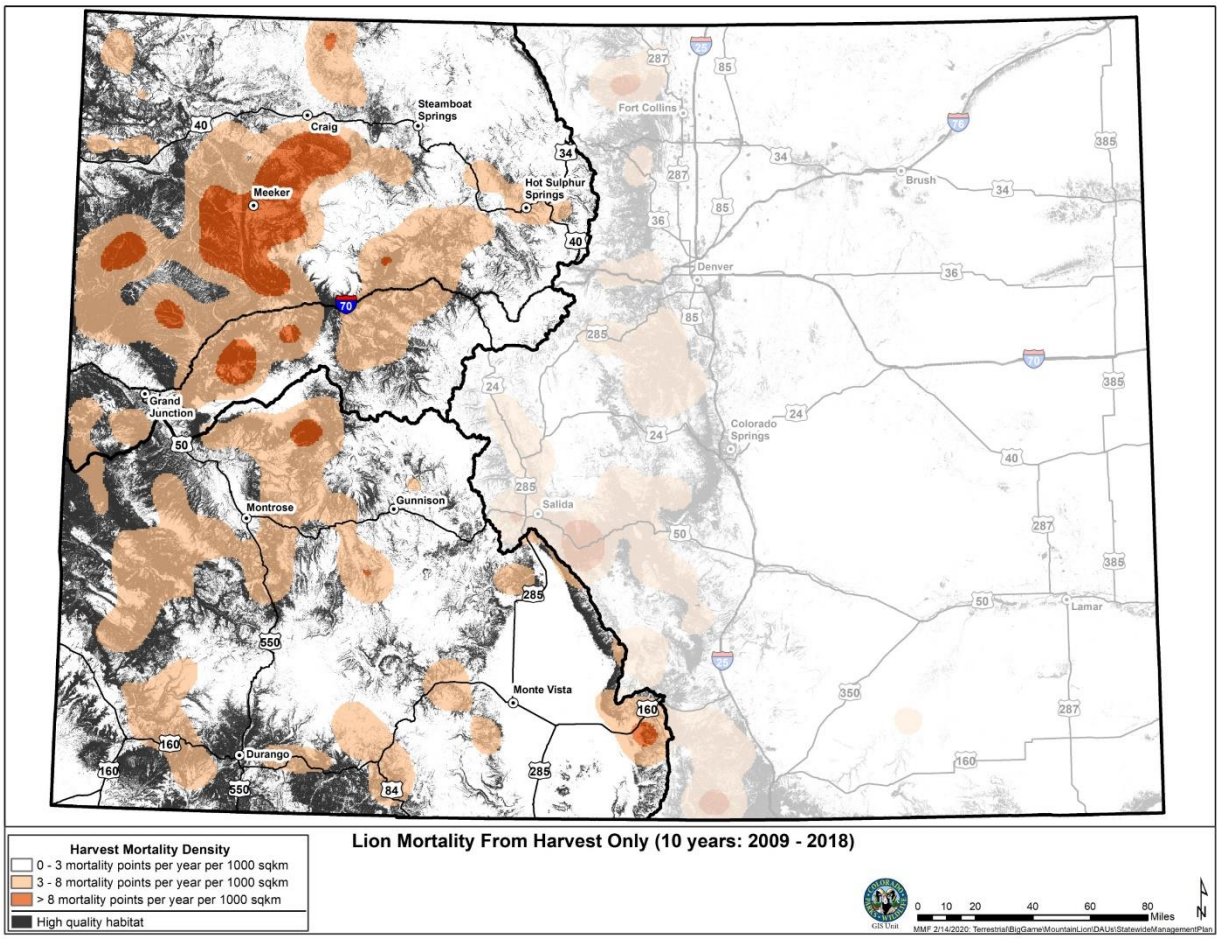

Figure 2. Upper 50%-100% percentile quality lion habitat from Colorado resource selection function model and 2009-2018 lion harvest mortality surface from the West Slope.

Zone Management

While the West Slope lion plan is not explicitly managing for defined source and sink areas or employing "zone" management across the two Regions (Logan 2019), the exercise described above is illuminating. It shows that in addition to monitoring mortality and harvest composition thresholds to ensure viability of Regional lion populations, Colorado's West Slope lions benefit from **49**% of the Northwest and Southwest Regions highest-quality lion habitat having virtually no lion harvest. These zones are functioning as refuges from harvest mortality. The fact that these robust source areas exist in abundance at large spatial scales and are well distributed across the West Slope affirms an additional safeguard in CPW's lion management strategy. The source areas promote a supply of immigrant lions and bolster recruitment, supporting population viability and resiliency across the entire landscape. The functional impact of having 49% of the West Slope's best habitat as a refuge zone, even if those areas are not explicitly defined by this plan or in regulations, cannot be overstated. Significant portions of both Regions are available to lions as "source" zones that offset any "sink" zones that are implemented through management or occur due to hunter harvest

patterns. As an example, Robinson and DeSimone's (2011) initial analysis of the Blackfoot watershed in Montana suggested that an area as small as 12% of a larger landscape that was without hunting mortality could act as a viable source with increased survival rates and ability to produce emigrants to other, more heavily harvested areas.

West Slope Regional Summaries

Northwest Regional Summary

Introduction and History

The Northwest Region contains large areas of highly productive mountain lion habitat. The highest quality mountain lion habitat occurs in western and southern portions of the Region, particularly in areas around Dinosaur National Monument in Moffat County, in the Piceance Basin in Rio Blanco and Garfield Counties, in the Bookcliffs and Roan Plateau in Rio Blanco, Garfield and Mesa Counties, and east into Eagle County. These areas are characterized by rocky terrain and pinyon-juniper woodland vegetation. They overlap the largest, and historically most productive, mule deer herds in Colorado. Lion habitat becomes less productive at higher elevations in the central and northeastern portions of the Region. Mountain lion management plans completed in 2004 call for a management strategy of stable mountain lion numbers throughout most of the Region, with the exception of the White River and Grand Mesa areas, which were previously managed to suppress mountain lion numbers. The Northwest Region has annually accounted for approximately 40% of statewide mountain lion mortality, with most of that mortality occurring as hunter harvest. Hunter harvest across the entire Northwest Region averaged 228 mountain lions annually in the 2016-2018 time period. Total human-caused mountain lion mortality over the same period averaged 258 lions annually. These recent rates of mountain lion harvest and total human-caused mortality represent historic highs. Non-livestock related lion conflict calls have increased in several areas of the Region within the past several years, particularly in Steamboat Springs, Eagle County and the Roaring Fork Valley (including Aspen). Conflicts include prolonged trail closures due to lion activity, depredation of pets and hobby livestock, and the June, 2016 mauling of a young child by a younger lion near Aspen.

Northwest Regional Monitoring Metrics

Lion populations will be managed for a Regional objective of a stable population. CPW will monitor total human-caused mortality and adult female composition in harvest annually. The two monitoring thresholds are:

1) The adult female composition in total hunter harvest at the Regional scale will not exceed 22% in any given year, excluding the Glenwood SMA.

2) The total human-caused mortality at the Regional scale will not exceed 17% of the RSF extrapolation, excluding the Glenwood SMA, on a 3 year average. In the Northwest Region, this equates to a Regional total human-caused mortality threshold of 269 lions.

Regional Harvest Objective

Evaluation of both monitoring metrics indicates that there is room for a modest increase in mountain lion harvest in the Northwest Region while continuing to manage for a stable mountain lion population consistent with the provisions of the West Slope Mountain Lion Management Plan.

Excluding the Glenwood SMA, mountain lion harvest in the Northwest Region between 2016 and 2018 averaged 212 lions annually. Given the flexibility to achieve a slightly higher harvest rate within the framework on the West Slope plan, the Northwest Region intends to increase the harvest rate of mountain lions above levels achieved in 2016-2018.

It is CPW's intent to maximize the use of licensed hunters in achieving lion management objectives within the Northwest Region. Mountain lion mortality attributed to control actions and other non-harvest events within the Region comprises a small portion of total annual human-caused mortality. Lion management conducted pursuant to this Northwest Regional plan will strive to maintain non-harvest lion mortality at a low level, with the remaining mortality directed toward harvest.

The Northwest Region harvest objective for 2021-2022 in GMUs excluding the Glenwood SMA will equal 243 lions annually (approximately 15% of the lion abundance index in those GMUs in the RSF). This Regional harvest objective will be divided among four harvest limit groups, as shown in Table 4. The NW Region harvest objective projects average non-harvest mortality as being similar to the most recent 3-year average.

Human Safety and Conflict

Human populations and lion populations show direct overlap in much of Colorado. In some instances, this overlap occurs in areas of relatively high human densities and development. Lions typically avoid people and are primarily active at times when humans are not. Nevertheless, co-occupancy of habitats may result in conflicts between people and lions. These human-lion incidents vary and run a continuum from mere sightings, depredation of or altercations with pets or hobby livestock, to human attack and injury or fatality. Given the current human population in Colorado and the anticipated population growth in the future, lion conflict levels will likely increase, especially in those areas where people continue expansion of human developments into occupied lion habitat. In addition, as this expansion occurs, the opportunity to effectively harvest lions is reduced because the traditional form of lion hunting (use of hounds) is largely incompatible with increasing human occupancy.

Opinions vary on appropriate lion abundance in suburban and ex-urban communities. Considerable agency effort is directed toward providing people information for managed coexistence with lions and these efforts will be continued for the foreseeable future. Nevertheless, CPW places human safety above lion occupancy, especially in areas of human residential development, where conflict has, or is expected to occur. In areas where conflicts between humans and lions are of increasing concern, special management may be necessary to find an appropriate level of tolerance for lions. CPW proposes the use of a Special

Management Area (SMA) to address primarily non-agricultural issues in ex-urban areas where an increasingly robust lion population is coming in conflict with increasingly high rates of human occupancy and land use. Appendix B provides a broader discussion on human-lion conflicts and human safety. In this plan, only one area has been identified on the West Slope for needing a SMA, and that is the community surrounding Glenwood Springs in the NW Region. The need, objectives and monitoring goals in the Glenwood SMA are described later in the NW Regional Summary.

Harvest Limits

Until now, mountain lion seasons and harvest in the Northwest Region was distributed at small scales, predominantly, to individual GMUs. For example, in 2017 and 2018, 33 separate mountain lion hunting harvest limit groups were used. All GMUs in the Northwest Region have been open for mountain lion hunting, except GMU 471, although that unit will be open in the 2020-2021 hunting season. Recent harvest distribution is presented in Table 5. This West Slope Mountain Lion Management Plan aggregates harvest limits into four harvest limit groups that include all GMUs within the Region, except those included within the Glenwood SMA (Figure 3, Table 6).

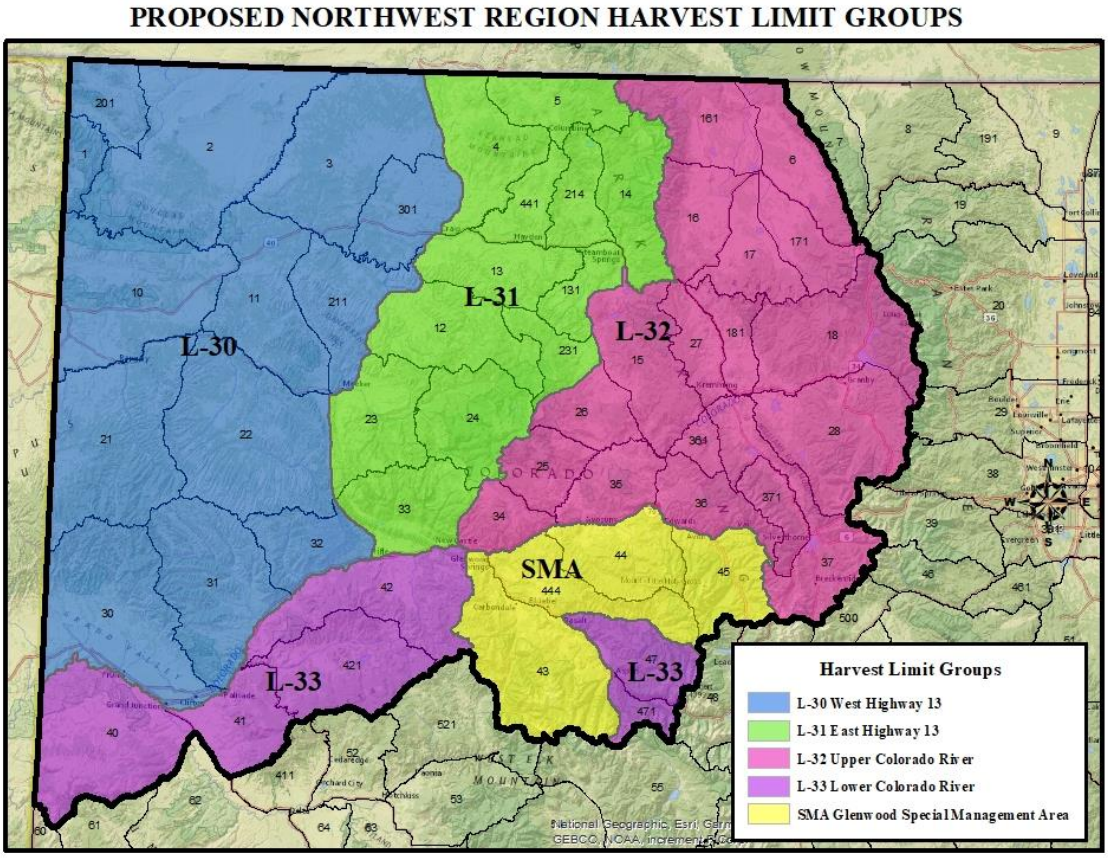

Figure 3. NW Region harvest limit groups for 2021-2022 lion season.

Table 5. Historic Northwest Region 2018 mountain lion harvest limit groups, harvest limits, and the 2016-2018 average annual harvest (rounded to nearest whole number).

List of GMU(s) in harvest limit group	2018 Harvest Limit	3-year Average Harvest
1, 2	7	4
3, 301	5	1
4, 5, 14, 214, 441	13	14
6, 16, 17, 161, 171	4	3
10	15	6
11	17	8
12	19	16
13, 131, 231	23	11
15	5	5
18, 27, 28, 37, 181, 371	12	10
21	17	14
22	17	17
23	18	14
24	7	6
25, 26, 34	7	6
30	11	6
31	17	11
32	7	4
33	17	7
35, 36, 361	9	9
40	7	7
41	5	3
42	10	8
43	7	5
44	6	6
45	1	0
47	1	1
201	8	4
211	29	7
421	10	10
444	7	5

Table 6. Northwest Region mountain lion harvest limit group name, GMUs and harvest limit for 2021-2022.

Harvest Limit Group Name	GMUs	Harvest Limit
L-30 West Hwy 13	1, 2, 3, 10, 11, 21, 22, 30, 31, 32, 201, 211, 301	91
L-31 East Hwy 13	4, 5, 12, 13, 14, 23, 24, 33, 131, 214, 231, 441	80
L-32 Upper Colorado River	6, 15, 16, 17, 18, 25, 26, 27, 28, 34, 35, 36, 37, 161, 171, 181, 361, 371	38
L-33 Lower Colorado River	40, 41, 42, 47, 421, 471	34
Glenwood Special Management Area (SMA)	43, 44, 45, 444	33

April Season

Historically, the Northwest Region has had very limited lion hunting opportunities during the month of April. Typically, most harvest limits were filled during the regular lion season from late November through March. In some areas, April seasons haven't been utilized to minimize impacts on other wildlife such as breeding and nesting sage-grouse and sharp-tailed grouse. The NW Region will initially implement this plan with all April seasons closed, with the exception of the Glenwood SMA harvest limit group. Opening April seasons could be an option for other harvest limit groups in the future if there is a need.

Electronic Calls

CPW will create regulations to make electronic calls legal for mountain lion hunting within the Glenwood SMA (GMUs 43, 44, 45, and 444). Electronic calls have proven to be an effective means in attracting lions to a hunter's location, although harvest from this method is less selective than with hound hunting. By bringing the lion to the hunter through the use of calls, hunters can control where the lion is harvested, thereby allowing hunters to hunt small pieces of private or public property. Electronic calls would also enable hunters who do not have access to hounds the opportunity to harvest a lion. Additionally, the use of electronic calls would better enable CPW to address conflict lions near residential areas and reach harvest goals.

Glenwood Special Management Area

The Glenwood SMA is comprised of GMUs 43, 44, 45 and 444 (Figure 3). This area encompasses most of the Roaring Fork valley and portions of the Eagle valley south of Interstate 70. Mountain lions have historically existed in these areas; however field observations and reported incidents over the past decade have all indicated a significant increase in both the number and severity of human-lion conflicts. Managers have become concerned that the

frequency of these conflicts is likely to result in human injuries or fatalities. Conflicts are likely high in the Glenwood SMA because local winter ranges occupied by mule deer within these GMUs are located in close proximity to urban and suburban areas, with additional areas containing substantial exurban housing development. Human activity levels within mountain lion habitats are high year-around. The combination of small parcel private land ownership, relatively dense human housing, and high degree of winter recreation all make the GMUs within this SMA difficult to hunt with hounds, which limits the impact that lion harvest can have on management. Lion management within this area will be governed by the management needs, objectives and monitoring metrics stated below.

The NW Regional goal of managing for a stable lion population is compatible with the independent objective of reducing human-lion conflict in these 4 GMUs. Harvest, total mortality and adult female composition levels within the Glenwood SMA are exempt from both NW Regional monitoring thresholds. However, the RSF extrapolated abundance index within GMUs 43, 44, 45 and 444 will also be excluded from calculations of the total human-caused mortality threshold for the Region (Table 2). In other words, both lion mortality and contributions to projected Regional abundance index from the Glenwood SMA will be excluded from any calculations or analysis of the Regional monitoring thresholds.

Glenwood SMA Need and Rationale:
Public reports of mountain lions in the Glenwood SMA were rare 10-20 years ago. Now reports number in the hundreds annually and come from a variety of groups and members of the community. Mountain lion reports have also changed in nature during this period from occasional sightings in the backcountry to videos and photos of lions basking on front porches in neighborhoods, roaming between vehicles on highways, and casually walking in the middle of the day down sidewalks. Reports of lions generally increased in winter and early spring when snow concentrated prey species in lower elevations nearer human development, more recently however, reports are now received year-round.

Changes in lion habituation to humans have been reported as well. Many calls report mountain lions that appear to have lost their fear of humans when confronted and exhibit behaviors consistent with being “habituated” to humans. The duration of time that lions have tolerated being close to urban and suburban settings has also increased, now lasting upwards of several weeks in some cases. Hazing efforts by CPW staff, landowners and other agencies have been largely unsuccessful in displacing lions from these settings in most cases, similar to the results of research documented by Alldredge et al. (2019).

Colorado Parks and Wildlife is statutorily liable for damage to livestock and has historically incorporated game damage objectives in lion management plans. Recorded game damage in and around the SMA has increased in the last 10 years when compared to the previous decade. From 1998 to 2008, there were 11 mountain lion damage claims paid in the local area, at a cost of $3,936. From 2009 to 2019, there were 21 mountain lion damage claims paid for a cost of $38,870. During these same 10 years however, the number of commercial livestock producers has decreased while hobby livestock owners appear to have increased.

Agency staff has increased public awareness to help reduce incidents through posting signs in residential areas, presenting information at homeowners association meetings, coordinating responses with local law enforcement agencies, providing recommendations to planners and developers with measures aimed at protecting residents and pets, providing information through traditional media, posting information on social media and teaching lion safety principles in annual school programs. Despite these efforts, CPW has needed to increase the frequency of use of hazing techniques, in addition to more efforts targeting individual conflict mountain lions for removal.

Glenwood SMA Goals and Objectives:
The goal of the SMA is to address human safety concerns by reducing human-lion conflicts, reduce lion occupancy in developed areas of high human use and to provide maximum hunting opportunity. Hunter harvest will be the primary tool for addressing an increasing mountain lion population and associated increasing conflicts. Harvest management tools such as longer and additional hunting seasons and permitting the use of electronic calls will help increase harvest and may allow for targeted harvest in areas of high conflict. Management tools will also include public education and strategic removal of individual lions that are dangerous by location or behavior. This SMA approach will be evaluated in an adaptive management framework to allow testing of some of the questions surrounding mitigating tools, including high harvest, heightened public education and management of individual animals in conflict situations, that will be used to reduce human-lion conflicts (Appendix B).

Harvest: The harvest limit in the four GMUs that comprise the SMA will be established at a level high enough that this SMA harvest limit group offers maximum hunting opportunity throughout the regular and April lion seasons(>25% harvest mortality, no human-caused mortality threshold and no adult female threshold).

Public Education: Public education on human wildlife coexistence remains paramount. CPW will continue to build and rely on partnerships with local governments, municipalities and organizations to find additional means of reducing conflicts. CPW continues to use various public information resources to provide information to communities and highlight the importance of living responsibly with wildlife. Common CPW recommendations include bringing pets in at night, not leaving pets unattended or tethered in yards, using fully enclosed outdoor kennels, use of outdoor lights, removing brush and grasses when landscaping, securing hobby livestock in enclosed barns/sheds and removing deer and elk food sources near homes that may attract prey species.

Individual Conflict: CPW continues to consider removal or translocation of individual lions, based on case-by-case specifics, as a main tool to mitigate human-lion conflict. This is particularly true in developed areas of the SMA where using a licensed hunter to harvest the individual lion is not practical.

SMA Objective Monitoring and Adaptive Management
Managing for a sustained reduction in human-lion conflicts will be monitored by various mechanisms. Information will be assessed over time to account for variations in external conditions, such as weather, which may alter the number of conflicts but cannot be controlled or replicated by staff. CPW staff collects human-lion incidents and records them in a system that can be referenced to evaluate progress towards the goal of reducing conflicts. CPW will use these records to measure increasing or decreasing trends in mountain lion conflict reports within the SMA.

To further evaluate that CPW is accomplishing the goal of reducing conflicts, staff will monitor the amount of time spent by officers in response to calls specific to lions and measure for increasing or decreasing trends. Management direction will continue towards a decreasing population until social metrics show a multi-year reduction in human mountain lion conflicts.

Given that the West Slope plan and Glenwood SMA strategy will guide management for at least the next 10 years, evaluation of success at reaching goals and objectives related to decreased human-lion conflict in the SMA will occur at an interim point, approximately 5 years into plan implementation. This formal evaluation will assess whether the number of recorded annual human-lion conflicts have been on a trend of reduction over that time. If this evaluation shows that the approach used in the first 5 years did not successfully produce a declining trend in conflicts, then adaptively, a different strategy with reduced levels of harvest will be employed for the second 5 years. Additionally, harvest limit fulfillment will be evaluated annually, with a particular focus on the success of each method and season in reaching harvest goals. The use of electronic calls will be a novel management tool, so assessing its efficacy in contributing to harvest will also be considered.

Southwest Regional Summary

Introduction and History
The Southwest Region has a variety of habitat and mountain lion prey abundance, and therefore a variety of lion densities likely ranging from marginal to very high. The Southwest Region has the lowest human population of CPW's four administrative regions. Much of the Southwest Region is public, agricultural or rural residential land. However, population clusters in the Uncompahgre, Gunnison, Dolores, San Juan and Animas river valleys overlap lion habitat and do experience occasional human-lion conflicts. Urban and exurban developments may provide attractants to lions such as residential deer, dogs at-large, and hobby livestock, as well as refuge areas where traditional hunter harvest is difficult.

Human-mountain lion interactions can vary from sightings of lions, to depredation incidents on pets or livestock to human attacks. Lions involved in these interactions are categorized in agency Directive W-20 as nuisance lions, which are frequently seen near people, kill and cache prey near homes, or as depredating lions which kill livestock, or dangerous lions. Lions

may be considered dangerous due to their location or their behavior. The Southwest Region will prioritize human safety when handling potentially dangerous human-lion interactions. Number and locations of nuisance, depredating, or dangerous lions are highly variable from year to year and are unpredictable.

Southwest Regional Monitoring Metrics

Lion populations will be managed for a Regional objective of a stable population. This will maintain viable lion populations and sustainable harvest compatible into the future. We will manage for a relatively stable Regional mountain lion population, and quality hunting opportunities with a diverse age and sex distribution in the harvest. The two monitoring thresholds are:

1) The adult female composition in total hunter harvest at the Regional scale will not exceed 22% in any given year.

2) The total human-caused mortality at the Regional scale will not exceed 17% of the RSF extrapolation on a 3-year average. In the Southwest Region, this equates to a Regional total human-caused mortality threshold of 284 lions.

Regional Harvest Objective

For the first three years of the Regional plan, the SW Regional hunter harvest objective will be set as approximately 11% of the RSF extrapolated abundance. Using this approach, the Regional annual harvest objective is calculated to be 185 lions, and total human-caused mortality is projected to be 219 lions. This is well below the mortality monitoring threshold.

This Regional harvest objective is a decrease from the pooled harvest limit of 194 (Table 7) that existed prior to the development of the West Slope Lion Management Plan. However, due to the great flexibility afforded to hunters by the large geographic harvest limit groups (as opposed to many small GMU-level limits, many of which were never achieved), we expect annual hunter harvest to increase from 147 lions to approximately 185 lions. Harvest limit changes are likely to occur in harvest limit groups that consistently reach harvest limits. In addition, this Regional harvest objective is substantially below the SW maximum total human-caused mortality threshold of 284 lions. This Regional harvest objective may incrementally increase and decrease as the adult female proportion and total human-caused mortality thresholds are monitored after the initial 3 years of implementing this plan.

Hunting opportunity in the Southwest Region is allocated to harvest limit groups (Figure 4 and Table 8) that differ from historic harvest limit groups (Table 7). Harvest limit allocations will be manipulated to create a balance between maintaining a viable lion population and staying below acceptable levels of conflicts with humans and livestock. On the large landscape level of the Southwest Region, harvest limits will be set to provide a broad spectrum of lion ages and densities on the landscape, as well as addressing hunter opportunity and satisfaction.

Harvest Limit

Mountain lion harvest limit groups were delineated according to the need to distribute harvest geographically while recognizing the landscape scale of mountain lion movements. The units are large enough to manage mountain lions on a landscape scale, group Game Management Units with similar geography, habitat, human cultural use, and regulation (method of take, April season, hunter harvest vs non-harvest mortality). This led to the creation of seven harvest limit groups in the Southwest Region loosely identified as the Dolores Canyon, Uncompahgre, North Fork, Gunnison Basin, San Luis Valley North, San Juan, and San Luis Valley South. Each harvest limit group will initially have a harvest limit greater than the current 3-year average harvest mortality. When summed across the Region, harvest is expected to increase approximately one-third of the difference between the 2019-2020 total harvest and the human-caused mortality threshold. This strategy will be evaluated for several years, at which time harvest limits may be adjusted to remain below the adult female monitoring thresholds while strategically maximizing harvest. As necessary, harvest limit groups and harvest limits may be adjusted at any time during the life of this management plan.

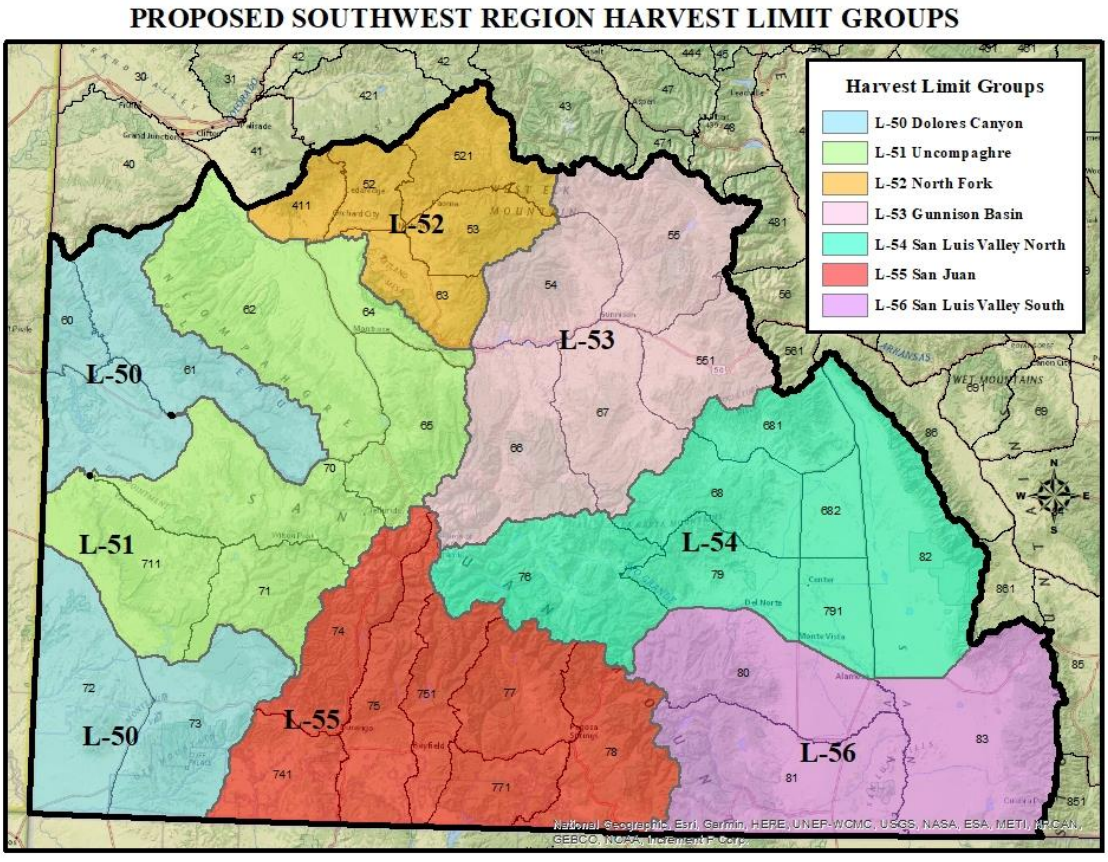

Figure 4. SW Region harvest limit groups for 2021-2022 lion season.

Table 7. Historic Southwest Region 2018 mountain lion harvest limit groups, harvest limits, and the 2016-2018 average annual harvest (rounded to nearest whole number).

GMU	2018 Harvest Limit	3- year Average Harvest
52,411	10	6
53,63	10	10
54,55,551	7	8
60	5	1
61	10	10
62	9	9
64	5	2
65	7	6
66,67	8	9
68,681,682	7	5
70 East	11	6
70 West	11	6
71,711	10	9
72	7	3
73	14	6
74,741	6	5
75	4	2
76,79,791	5	5
77	6	7
78	5	5
80	5	5
81	5	2
82	6	3
83	10	9
521	6	6
751,771	5	3

Table 8. Southwest Region mountain lion harvest limit group name, GMUs and harvest limits for 2021-2022.

Harvest Limit Group Name	GMUs	Harvest Limit
L-50 Dolores Canyon	60, 61, 70W, 72, 73	31
L-51 Uncompahgre	62, 64, 65, 70E, 71, 711	48
L-52 North Fork	411, 52, 53, 63, 521	31
L-53 Gunnison Basin	54, 55 ,66, 67, 551	18
L-54 San Luis Valley North	68, 76, 79, 82, 681, 682, 791	16
L-55 San Juan	74, 75, 77, 78, 741, 751, 771	23
L-56 San Luis Valley South	80, 81, 83	18

April Season

Under this plan, the Southwest Region will initially close all harvest limit groups during the April hunting season each year. In the recent past, there have been several GMUs open for hunting in April including 70, 71, 72, 73, and 711. Several of these are proposed to have expanded opportunity via electronic calls (see below), while others are included in L-51, which has typically achieved harvest limits during the November-March period. The remaining GMUs in the Southwest Region have traditionally not had an April season because the units have met the harvest objective in the November-March time period or wildlife managers recognize potential conflict with Gunnison sage-grouse during a critical period of their breeding season.

Electronic Calls

Colorado Parks and Wildlife will create regulations to make electronic calls legal for mountain lion hunting in harvest limit group L-50 (GMUs 60, 61, 70W, 72, and 73). Although large portions of the Region are comprised of public property, mountain lion hunting with hounds is difficult in areas of small property ownership patterns in Montezuma, Dolores, and Montrose Counties. Much of the low elevation deer and elk winter range in this area has poor or non-existent snow-tracking conditions in most winters and is therefore difficult to hunt with hounds, though it is still excellent lion habitat. L-50 is made up of a checkerboard pattern of public and private land; this can make accessing some of the public land difficult without permission from a landowner. Keeping hound pursuits only on the property that hunters have permission to hunt can also become quite challenging due to the smaller parcel size of both private and public property. Consequently, there is a limited amount of opportunity for lion hound hunting in these areas. Most of these GMUs rarely, if ever, meet their harvest limit. The result has been an increase in lion sightings and conflicts. The hunting public has an

interest in harvesting lions in these area; hunters just need a method that would give them an opportunity that currently does not exist.

Electronic calls have proven to be an effective means in attracting mountain lions to a hunter's location, although harvest from this method is less selective than with hound hunting. By bringing the lion to the hunter through the use of calls, hunters can control where the lion is harvested, thereby allowing hunters to hunt small pieces of private or public property. Electronic calls would also enable hunters who do not have access to hounds the opportunity to harvest a lion. Additionally, the use of electronic calls would better enable CPW to address conflict lions near residential areas and reach harvest objectives. We can measure success by identifying electronic call-assisted harvest locations closer to suburban/urban areas, increased harvest, and a reduction in conflicts. Adult female harvest composition in these units will be monitored to see if harvest proportions increase above 22% in any year; harvest limits and methods will be reevaluated if this threshold is exceeded.

Management Plan Update & Revision Process

As is appropriate with lions, this plan initiates a long-term management framework for the entire West Slope. Colorado Parks and Wildlife's management plans should be based on credible scientific information, informed by and responsive to the diversity of public interests and concerns, and readily available to the public. Management plans provide an accountability mechanism for agencies that manage lions as a public trust resource. However, management plans that persist over long time periods risk becoming unresponsive to new scientific evidence or may outlast changing perspectives of citizens or resource management demands. A common criticism of management plans is that they are overly restrictive and unresponsive to either changing management conditions or to newer information. The challenge is to create guidance that is firm enough to truly guide management but that is also adaptive to new scientific information, new opportunities to test management applications, and new demands placed upon the agency. Periodic review and examination of new scientific information relevant to the management assumptions contained in this plan should be conducted as needed.

Public Planning Process

A more complete description of the public process and summaries of feedback received on the West Slope lion plan are included in Appendix E. Public outreach efforts, designed to inform the public of the proposed planning process and collect input, began in January of 2020. Twelve in-person public meetings were hosted across the by CPW staff beginning in February 2020. Approximately 584 individuals attended the in-person presentations with 360 attendees providing written survey feedback. The agency also conducted a Facebook Premier event featured a recording of the same presentation given at West Slope in-person meetings and included a recorded question and answer session to common themes we heard from earlier meetings. Over 32,000 views were recorded in the first full day of the video being

posted. The draft West Slope lion management plan and associated appendices were posted to the CPW mountain lion webpage on CPW's website on March 12, 2020 and closed on April 30, 2020 (~ 6 weeks) for public review and commenting. During this draft plan review period, 1,855 formal public comments were received.

Lion Density Monitoring and Future Research Needs

Lion Density Monitoring

Developing robust estimates of current lion density in survey areas on the West Slope will help improve and refine assumptions made in the RSF model. Empirically-derived estimates will also serve to confirm projected cumulative Regional abundances in the range of 2-3 independent lions/100 km^2 that are being applied as part of the West Slope plan to generate the total human-caused mortality threshold.

Beginning in 2020-2021, CPW will identify two survey areas on the West Slope that are representative of quality lion habitat and that reflect a gradient of lion hunting pressure. A spatial mark-resight density estimation approach will be used, which produces more precise estimates of lion numbers than mark-recapture efforts used in the past (Alldredge et al. 2019, Murphy et al. 2019). This survey technique relies on remote game cameras distributed across the survey area to "resight" lions from repeated photos over time. A proportion of lions in the population are "marked" using GPS collars labeled with unique visual identifiers. The proportion and capture pattern of known marked lions versus unmarked individuals allows estimation of density. Spatial data acquired from GPS collars addresses geographic closure and improves density estimates based on the proportion of time each collared lion spent on the survey area (Alldredge et al. 2019, Murphy et al. 2019). This correction tends to reduce overall density estimates, but results in a more accurate estimate. To achieve a desired precision so the estimates are meaningful in the context of evaluating the RSF, each survey area would likely be around ~2,000 km^2 and will require handling and marking approximately 20-25 independent lions. Each study area will be divided into around eighty 25 km^2 cells and a remote game camera and call will be installed in each cell. Resight sampling will occur for a minimum of 8 weeks during February and March. This time period was chosen because bears will not be active at this time and most of the cougar harvest will be completed at this time. Therefore, estimated lion densities will represent a post-hunt estimate on winter range, similar to the techniques and procedures currently being employed in CPW's Upper Arkansas research project. These West Slope survey area densities will serve to support and align CPW's RSF modeling process and its' resulting abundance projection outputs to accurately reflect lion population status currently in the field.

Future Research Needs

Numerous avenues of potential research exist into the future in Colorado. Some are already underway, others require commitment of significant resources that are outside the framework of this plan, and others may be best evaluated after several years of implementing this West

Slope Mountain Lion Management Plan. Below are several topics that have been identified as future research needs.

- Investigate and update research on public perceptions and opinions about lion management in Colorado.
- Further evaluate the hypothesis that the social disruption caused by intensive lion harvest or removal of adult males is related to increases in human-lion conflicts.
- Evaluate presumed source and sink locations to determine if predictions reflect functionality.

Colorado West Slope Mountain Lion Management Plan
APPENDIX A

MOUNTAIN LION LIFE HISTORY, ECOLOGY, AND MONITORING

Introduction: This review of current scientific literature begins by briefly describing where and how lions live in Colorado, including a review of lion densities, and predator-prey relationships. Specific attention is devoted to lion predation on mule deer because of a high level of interest in these relationships and how they might relate to recent declines in mule deer populations. Lastly, a summary is provided of both commonly used field and harvest index-driven methods to monitor lion populations.

Distribution

The historic range of the mountain lion (*Puma concolor*) was the largest of any terrestrial mammal in the Western Hemisphere, with the exception of humans (Logan and Sweanor 2001). The lion continues to range from the southern tip of South America to northern British Columbia (Logan and Sweanor 2001) but was apparently extirpated from the eastern US and Canada, with the exception of southern Florida, by the late 1800s to early 1900s. Between the mid-1960s and the early 1990s, lion populations increased in many western states and they expanded their distribution into Nebraska, South Dakota, and North Dakota. In Alberta, Canada, lion distribution has expanded to the north and east during the past two decades (Knopff et al. 2010). The Cougar Management Guidelines Working Group [CMGWG] (2005) and Fecske et al. (2011) suggest that population recovery and expansion may be due in part to reclassifying lions from unregulated predator status to game animal (which has regulated human off-take since 1965), science-based management practices, increases in prey abundance, restricted uses of predicides since the 1970s, and increased human tolerance for large carnivores.

On the West Slope of Colorado, lions occupy most timbered and tall shrub covered habitats. In comparison to other Rocky Mountain States, western Colorado possesses high-quality, well-connected lion habitat with the capacity to support high lion abundance. The relatively high-quality habitat on the West Slope is due in part to an abundance and diversity of lion prey species, coupled with optimal vegetation and topographic structure.

Dispersal patterns and genetic evidence suggest that lion populations throughout most of the western US are well connected (Culver et al. 2000, Sinclair et al. 2001, Anderson et al. 2004). Extreme movements of male lions in excess of 1,000 km have been documented (Thompson and Jenks 2005). These long-range movements provide a very effective means of genetic transfer and population maintenance to lion populations in distant regions. Gene flow among lion populations in the Central Rocky Mountains suggests this region exists as one large lion population with rapid genetic exchange among suitable habitat patches throughout the region

(Anderson et al. 2004). Consequently, little or no genetic population structuring has been found in Colorado (Sinclair et al. 2001, McRae 2004).

Habitat Use

The broad geographic distribution of the lion in North America attests to its ability to persist in natural habitats wherever there is adequate prey and cover (CMGWG 2005). Previous lion habitat studies in the western US suggest lions select conifer, deciduous timber, riparian, and tall shrub habitat types at mid-high elevations in steep or rugged terrain (Logan and Irwin 1985, Laing 1988, Koehler and Hornocker 1991, Williams et al. 1995, Dickson and Beier 2002). Tall vegetation or rugged terrain sufficient for concealment provides the necessary hiding and stalking cover for securing prey and raising young (CMGWG 2005). Lions may be found in climates ranging from arid regions of desert environments to temperate rainforests of the Pacific Coast. Vast, open areas with little hiding cover and severely cold winter temperatures of northern climates may restrict lion use (Pierce and Bleich 2003). It may be that the basin bottom of a few mountain "parks" on the West Slope meet this description.

Despite the lion's broad distribution and adaptability, habitat fragmentation that is associated with human development can negatively impact lion populations (Beier 1993, Vickers et al. 2015). In southern California, major highways were implicated in restricting the size and arrangement of lion home ranges and restrict gene flow in populations by constraining dispersal patterns (Riley et al. 2006). Genetic analysis and Global Positioning Systems (GPS) location data for a monitored lion population in northern Colorado did not demonstrate any similar results as Riley et al. (2006) found in California (Alldredge 2015). The magnitude of the human population in the Greater Los Angeles Area (>20,000,000) may explain the differences in observations. Nevertheless, increased construction of roads and homes in lion habitat may reduce the amount and quality of habitat available to lions and their primary prey [e.g., deer and elk], but may increase the number of alternative prey sources [raccoon, fox, domestic pets and hobby livestock]. Moreover, medium to low density ex-urban development in parts of Colorado serve as refugia for mule deer and can experience higher densities of mule deer than those found in similar public land habitats (Colorado Parks and Wildlife (CPW) Terrestrial Section unpublished data).

Lion Social Structure and Reproduction

Social behavior of lions likely evolved to maximize individual survival and reproductive success (Logan and Sweanor 2001). Lions are solitary carnivores exhibiting a polygynous breeding strategy where dominant males typically breed with females that reside within their home range (Murphy 1998). Resident males aggressively defend their territories against male intruders, whereas females allow more overlap, but express mutual avoidance (Lindzey et al. 1989, Ross and Jalkotzy 1992, Logan and Sweanor 2001). Size of female home ranges tend to be large enough to provide sufficient prey for themselves and their young (~50-100 km^2, 20-40 mi^2), while male home ranges tend to be larger (~150-300 km^2, 60-120 mi^2), overlapping several females, apparently to maximize their reproductive success (Murphy 1998). Home ranges found in Colorado vary widely; from 309 km^2 for females and 503 km^2 for males on the Uncompahgre Plateau (Anderson et al. 1992) to 188 km^2 for females and 253 km^2 for males on

the Southern Ute Indian Nation in southwestern Colorado (Koloski 2002). In recently completed research on the Uncompahgre Plateau and along the Front Range northwest of Denver, Colorado home range sizes are similar to, if not slightly larger than, those reported by Murphy (1998)(Ken Logan, CPW, personal communication 2015, Mat Alldredge, CPW, personal communication 2020). Young females commonly express philopatric behavior (remain in their natal range) upon independence, but males typically disperse from their natal range (Anderson et al. 1992, Ross and Jalkotzy 1992, Lindzey et al. 1994, Logan and Sweanor 2001).

Lion densities are low relative to other large mammals ranging from about 1 independent (>12-18 months old and self-sufficient) lion/100 km^2 (38.6 mi^2) in arid climates (Ashman 1976, Lindzey et al. 1994) to nearly 5 independent lions/100 km^2 in generally more mesic areas (Currier et al. 1977, Hopkins 1989, Ross and Jalkotzy 1992, Robinson et al. 2008, Cooley et al. 2009*b*, Proffitt et al. 2015) (Table 1). Whittaker and Wolfe (2011) point out that density estimates are strongly influenced by the methods used to assess the population size in a given area. This may help explain why in some cases, more recent non-invasive techniques and spatially-explicit models have yielded density estimates on the higher end of the previously-observed range.

Table 1. Mountain lion densities reported or derived from surveyed areas in the western United States and Canada, 1977-2019. All densities reported as the number of lions per 100 km^2.

Location	Vicinity	Survey Area Size (km^2)	Independent Mountain Lion Density	Total Mountain Lion Density	Number Survey Years	Notes	Reference
Washington	NE- Wash.	2878	2.2	2.1-2.6	9	Hunted	Beausoleil et al. 2016
Colorado	Boulder	800	4.1		3	Lightly hunted	Alldredge et al. 2019
Colorado	Canon City	1950	4.8 (1.8-7.7)		1	Hunted	Currier et al. 1977
Utah	Monroe Mts	1300	1.2-3.2		9	Hunted	Stoner et al. 2006
	Oquirrh Mts	480	2.5-2.9		8	Unhunted	
Wyoming	Snowy Mts	383	2.4		1	Pre-treatment. Then thru 2 treatment yrs followed by 3 recovery yrs.	Anderson and Lindzey 2005
		439	3.4				
		1700	1.2-3.2		5		
Wyoming	Bighorn Mts	741	1.8-2.3	3.5-4.6	2	Hunted. Kittens defined as <24mos comprised 50% of the pop.	Logan et al. 1986
Montana	Bitterroot Mts	2625	4.5-5.2		1	Hunted	Proffitt et al. 2015
Washington	NE-Wash.	735		5.0	6	Hunted, Kittens <12mos = 30% of the population	Robinson et al. 2008
Montana	Blackfoot drainage	7908		3.7 (2.3-5.7) 6.7 (3.1-11.0)	1	Hunted	Russell et al. 2012
Montana	Garnet Mts.	915		4.0	11	Yr 1 Unhunted, Kittens <12mos = 30% of population across all years of study	Robinson and DeSimone 2011
				2.2		After 3 yrs Hunted	
				3.6		After 3 yrs Hunted w/refugia in part of area	
New Mexico	San Andreas Mts	2059	1.5-2.1	1.7-4.3	7	Simulated hunting effect	Logan and Sweanor 2001
Washington	West-central	655		3.6 (3.0-4.2)	5	Lightly hunted	Cooley et al. 2009*b*
	NE	772		3.5 (2.8-4.2)	5	Heavily hunted	
Oregon	NE Oregon	225		4.2-5.0	1	Hunted	Davidson et al. 2014
Utah	South-central	1900	0.4-0.9	0.6-1.4	9	Unhunted	Lindzey et al. 1994
Utah/Idaho	SE-ID & NW-UT	1700	1.0-2.1	1.6-2.8	15	Hunted	Laundre et al. 2007
Alberta	Sheep River	780	2.6	2.7-4.7	8	Hunted. Kittens/"juveniles" defined as <24 mos. are not included in the average independent density	Ross and Jalkotzy 1992
British Columbia	SE-BC	540	1.5-1.7	3.5-3.7	2	Unhunted, but hunted prior to study. Kittens/"juveniles" defined as <24 mos. = 50-58% of population and are not included in the independent density	Spreadbury et al. 1996
Idaho	Idaho Primitive Area	520		1.7-3.5	8	Hunted, Kittens/"juveniles" defined as <24 mos.	Seidensticker et al. 1973

Female lions typically produce their first litter at 2-3 years old (Anderson 1983, Ashman et al. 1983, Logan and Sweanor 2001) and may breed at any time of the year, but exhibit seasonal birth pulses. Data from 7 lion studies in western North America indicate that May through October are the peak months for lion parturition (CMGWG 2005). Gestation lasts 82-96 days and lions typically produce 2 to 4 young (Logan et al. 1986, Ross and Jalkotzy 1992, Logan and Sweanor 2001). Kittens are usually weaned at 2–3 months and typically remain with the female for 12–18 months before becoming independent (Pierce and Bleich 2003).

Food Habits and Prey Relationships

Lion diets consist primarily of large vertebrate prey species. Throughout much of North America, deer comprise the majority of lion diets (Pierce and Bleich 2003), but other large ungulates such as elk (*Cervus canadensis*), bighorn sheep (*Ovis canadensis*), moose (*Alces alces*), and pronghorn (*Antilocapra americana*) may also be consumed (Ross and Jalkotzy 1996, Ross et al. 1997, Murphy 1998, Anderson and Lindzey 2003). Although lions primarily subsist on large ungulates, small mammals including porcupines (*Erethizon dorsatum*), raccoons (*Procyon lotor*), lagomorphs (hares and rabbits), ground squirrels (*Spermophilus* spp.), and beavers (*Castor canadensis*) may also supplement lion diets. Lions also occasionally prey on domestic livestock and pets. Sheep and goats are the most commonly killed domestic livestock, but lions also kill cattle, horses, and pets including dogs and cats (CMGWG 2005). Scavenging is also a more important contribution in lion diets than was believed 20-30 years ago (Knopf et al. 2010, Blecha et al. 2015).

Scientific efforts reveal the complexity of predator-prey relationships, yet many people are not well versed in this understanding (Murphy et al. 2011). A fundamental understanding of predation consequences is required in order to meet societal goals for prey and predator populations (Gassaway et al. 1992). Failure to correctly apply the key principles of predator-prey interactions invites management mistakes, can misspend money (Kie et al. 2003) and may erode public confidence in management agencies. These points stress the importance of reviewing and incorporating into management the most current and relevant scientific information regarding predator-prey relationships.

In single prey systems, predation by cougars and other predators is not believed to widely trigger declines of prey or depress prey populations for extended (>15 years) time periods (Ballard and Van Ballenberghe 1997, Ballard et al. 2001). However, if extreme weather or other perturbations significantly lower prey numbers below maximum sustained yield (Figure 1) predation may delay the prey's density-dependent response and prolong low numbers. This effect may occur if the expected drop in cougar numbers naturally lags behind that of the primary prey (Logan and Sweanor 2001, CMGWG 2005, Laundré et al. 2006), as is common for population cycles of Canada lynx (*Lynx canadensis*) and snowshoe hares (*Lepus americanus*) in Canada and Alaska. The density dependence model of mortality should be one that is highly familiar to hunters in North America because it is a foundational principle for hunting many game populations. Under this paradigm of wildlife management, hunters take animals that may die from other causes ("compensatory" mortality), but they are only removing this surplus of animals from the population. It is only when wildlife agencies determine that

additional mortality is necessary to manage wildlife populations that harvest and license levels are increased to allow hunters to take more animals. This regulated increase in harvest to reduce population size is then considered "additive" mortality (NFRTC 2001, CPW Hunter Education 2014).

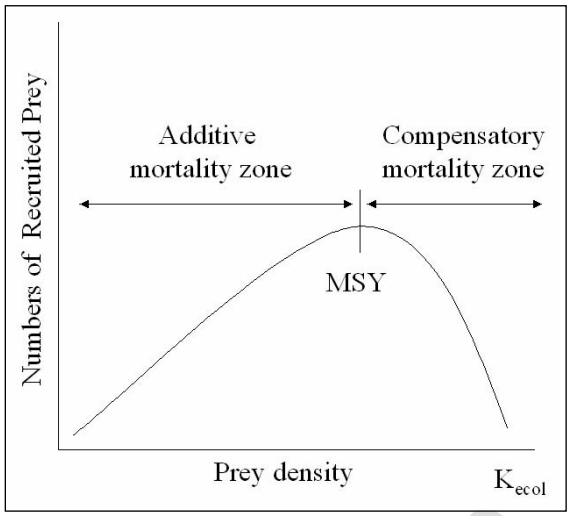

Figure 1. Density dependence: the relationship between the number of prey recruited and the density of the prey population. At low prey numbers mortality tends to be additive. At high prey numbers mortality tends to be compensatory. (Murphy et al. [2011] derived from McCullough [1979], Bailey [1984], and Bowyer et al. [2005])

Under some circumstances, in multiple prey systems, cougars may have sustained limiting effects on their large or mid-sized prey (Berger and Wehausen 1991, Sweitzer et al. 1997, Krausman and Shackleton 2000, Ballard et al. 2001, Kinley and Apps 2001, Novaro and Walker 2005, Wittmer et al. 2005). At the extreme, cougar predation, often acting in concert with other factors, also may reduce the viability of small or declining prey populations and mammalian diversity (Sweitzer et al. 1997, Ernest et al. 2002, Wittmer et al. 2005). These situations often involve a mix of primary and alternate prey (wild or exotic) as well as human-induced changes in plant communities that collectively help maintain cougar numbers. In these situations, predator populations that would normally decrease as their prey populations are reduced are supported by other, more numerous prey populations (Pierce and Bleich 2003). In most of Colorado, it is likely that lion predation functions primarily within the multiple prey model; on the Uncompahgre Plateau and the northern Front Range areas lions preyed on mule deer and elk, and in the northern Front Range small prey played a significant role in lion diet (Blecha et al. 2015, Moss et al. 2016).

The potential impacts of lions on prey populations are largely dependent on the condition of the prey and their habitat. In areas where prey habitat is in good condition, prey body condition will also be greater. Thus, more individuals in the prey population are likely to survive in the absence of predation. However, in prey populations where individuals are in poor condition due to poor forage quality, those individuals are more likely to die regardless of predation. Therefore, lion predation on ungulates in good physical condition is more likely

to be *additive* to other causes of mortality. Conversely, lion predation on ungulates in poor physical condition (that is, ungulates in populations that exceed K_{ecol} [*ecological carrying capacity*]) is more likely to be *compensatory* (Logan and Sweanor 2001)(Figure 1). In addition, healthy prey populations likely exhibit higher reproductive rates and are more likely to offset predatory regulation by producing more young than are consumed by predators. Ungulate populations exhibiting the characteristics of limitation by predation (Table 2) may benefit from increased lion harvest. Prey populations limited mainly by habitat conditions will not likely benefit from increases in local lion harvest except during the initial phases of habitat recovery allowing more rapid response of the prey population to improved forage conditions. Additionally, in situations where abundant alternate prey are lacking, a decline in lion numbers will naturally follow the decrease in the ungulate population regardless of lion harvest levels (CMGWG 2005).

Table 2. Characteristics of ungulate-prey populations regulated by predation and populations regulated by forage conditions (CMGWG 2005, page 15).

Life history characteristic	Population size mainly affected by predation[b]	Population size mainly affected by forage
Physical condition of adult females	better	poorer
Pregnancy rate of adult females	higher	lower
Pause in annual production by adult females	less likely	more likely
Yearlings pregnant[a]	usually	seldom
Corpora lutea counts of adult females[a]	higher	lower
Litter size[a]	higher	lower
Age at first reproduction for females	younger	older
Weight of neonates	heavier	lighter
Mortality of young	additive	compensatory
Age at extensive tooth wear	older	younger
Diet quality	higher	lower

[a]Some species of ungulates may show limited variability in these characteristics.

[b]These traits will be evident in *any* population far below carrying capacity, even if it experiences *no* predation. The manager should have evidence that predation is a limiting factor before concluding that reducing predation would increase ungulate recruitment.

The extent to which lion predation influences the abundance of ungulate populations seems to depend upon the ungulate population size, its productivity, the quality of its habitat, the presence of alternate prey, and lion abundance. Most notably, lion predation can suppress the growth of small, island-like populations of bighorn sheep (Ross et al. 1997, Kamler et al. 2002, Rominger et al. 2004*a*, Rominger et al. 2004*b*). In addition, the effect that lion predation can have on a small population of bighorn sheep can be influenced by the presence of more abundant prey, such as mule deer, that is more important to provisioning the lions on the same range (Johnson et al. 2013).

Lions have annually removed an estimated 15-20% of a mule deer population on the Kaibab Plateau, Arizona (Shaw 1980), 8-12% of a mule deer population on the Uncompahgre Plateau,

Colorado (Anderson et al. 1992), and 2-3% of elk and 3-5% of mule deer in the northern Yellowstone Ecosystem (Murphy 1998). Yet, the mere presence of predation does not necessarily indicate that an ungulate population is limited by predators. Nor does lion predation necessarily indicate suppression or regulation of the prey population (Ballard et al. 2001). For example, in the Chihuahua desert of southern New Mexico where neither the lions nor the mule deer were hunted, Logan and Sweanor (2001) revealed that the effect of lion predation on a population of deer was conditional upon deer habitat quality as influenced by weather. Lion predation apparently slowed the rate of growth of the deer population, but did not stop it from growing during good habitat years. The data indicated that lion predation was partially additive and partially compensatory as the deer population grew, but it was strongly compensatory as the deer population declined during the drought. In California, Pierce et al. (2012) examined the relative strengths of predation, mostly by lions, and habitat quality on a mule deer population and found that predation slowed but did not prevent deer population growth when food was not limiting the deer. They concluded that deer mortality during a time that the deer population declined and was at (or near) winter range carrying capacity, was mostly compensatory. However, during the time when the deer population was rebounding from a low phase and not limited by food, lion predation was likely additive mortality.

Researchers in the New Mexico and California studies identified a period when lion abundance lagged behind the deer population decline, and that it was during this time that lion predation had the strongest affect. Evidence indicates that the lag period for lion numbers following deer declines could be 4 to 8 years (Laundre et al. 2007, Pierce et al. 2012).

Other investigations of mule deer population trends have demonstrated population expansion and contraction highly correlated with the availability and quality of forage (Clements and Young 1996, Peek at al. 2002). Winter severity of the current and previous year's winters were the most influential predictors of deer population growth rates in Idaho. In that study, lion control was able to increase fawn:doe ratios, but did not affect deer population growth (Hurley et al. 2011). A number of recent studies support a conclusion that the potential abundance of mule deer is determined mainly by the nutritional quality and availability of forage and not by lion predation (Bishop et al. 2005, Bender et al. 2007, Hurley et al. 2011, Pierce et al. 2012, Montieth et al. 2014). Monteith et al. (2014) suggested a path forward through a model that predicts expected population demographic rates through measuring nutritional carrying capacity (NCC). Their approach focuses on the capacity of the habitat and reduces the need to estimate population abundance. The degree that predation is compensatory or additive can be assessed by comparing the estimated nutritional capacity for survival and recruitment of young based on the predictive model developed by Monteith et al. (2014) to those same demographic rates measured empirically in that system. This would be useful for quantifying the effects of predation and provides a basis for determining the likely efficacy of predator control to enhance ungulate populations.

Bergman et al. (2015) examined the published evidence about mule deer population management and concluded that herds in Colorado are most likely limited by the quality of

available winter range habitat and that the influence that lion predation may have on mule deer population dynamics (that is, variation in growth rates) is poorly understood. Considering the abundance of lion habitat in Colorado and the conservative approach to lion harvest strategies, they posit that lion predation on mule deer is probably weakly additive.

Even in a system when lion predation is primarily compensatory, hunters may be in competition with lions for preferred prey (i.e. mule deer). If demand for mule deer is high (hunter interest) and access to the resource is constrained (limited licenses), then deer dying from other means can be seen, at least by some, as lost hunting opportunity. Lion predation can be viewed as competition for access to the resource. The conflict here results from the tension between a short-term desire for hunting opportunity and a long-term view of population management of both lions and mule deer. Ultimately this isn't a matter of biological capacity or ecological function; these considerations are outside the bounds of what must ultimately be a value-driven decision regarding mule deer and lion management. If lions are perceived as competitors for a limited resource such as mule deer, some may seek reductions in lion numbers to lessen this competition. Determination of how much deer mortality from hunters and how much deer mortality from predation is acceptable is not a decision that science can make. It is a value-based decision, which must be left to evaluation in the social, and not biological, realm.

The body of evidence suggests that in most cases, efforts to reduce lion predation impacts to mule deer are likely to be expensive and the effect, if any, is likely to be relatively short-lived. Such efforts are also likely to be unpopular with some non-hunting segments of the human population.

Mountain Lion Population Monitoring

Although lion populations have previously been monitored with intensive capture efforts over relatively small areas, reliable and affordable techniques to monitor lion populations for large-scale management programs are lacking. The two main approaches to lion population monitoring are field methods and harvest data analysis. Field methods may obtain information directly about lion abundance, demographics and vital rates and/or population trend, whereas harvest data analysis can provide indications of population trends.

Field Methods

Field methods pertain to efforts by biologists to gather data on lions directly or indirectly via evidence they leave in the environment. Some methods are used to estimate lion numbers, while others are indices to relative lion abundance.

Complete Enumeration: Very intensive field efforts to capture, tag and radio-collar lions along with GPS/radio-tracking to discern movements of unique individuals to combine with ground-tracking and harvest information have provided the most reliable estimates of lion abundance in specified study areas (CMGWG 2005). This method produces high-quality data on

sex and age structure, survival, agent-specific mortality, reproduction, emigration, and other animal movements that generally cannot be obtained with the other methods. This method is the most expensive and is impractical for lion management on a broader landscape scale, where only abundance estimates are of focal interest, such as the historic Data Analysis Unit (DAU) or Regional scale on the West Slope of Colorado.

Mark-Recapture: Chapman's 1951 modification of the Lincoln-Peterson (L-P) estimator (Pollock et al. 1990) was used in an effort to estimate lion numbers in Wyoming (Anderson and Lindzey 2005) and Utah (Choate et al. 2006). The Wyoming effort used a captured and marked sample of lions at the beginning of each sampling period and used lions killed by hunters and observed by researchers after the hunting season as the recaptured sample. Population estimates had 95% confidence intervals ±19-37% of the estimates (n = 5). The Utah study derived population estimates by determining the identity of lions that they detected from their tracks on snow as either marked or unmarked by using radio-telemetry or by pursuing the animal to capture and observe it. The estimates tended to adequately track the changes in the reference population. But, estimates were on average negatively biased by 17 ± 14%, and 95% confidence intervals were widely variable from ± 0 to 50% of the estimates (n = 7, Monroe Mts., Choate et al. 2006). Multiple capture occasions can be designed into the mark-recapture field operations with the intent to achieve greater precision in population estimates and allow more mark-recapture-type models to be applied in terms of modeling the data (e.g., variations in capture probability by animal type, time, observer, and incorporation of covariates) (Amstrup et al. 2005). These methods are suitable for intensive research on a specified study area, especially to establish a reference for local population abundance and attendant effects of manipulation and experimentation.

Russell et al. (2012) gathered genetic samples from lions one winter in a management unit-size area (7,908 km^2) in Montana. They used a combination of a non-invasive method (back-tracking to collect hair samples) and treeing and biopsy darting lions to genotype individuals, and used spatial capture-recapture models to estimate abundance. Their lion density estimates, including all lions (i.e., adults, subadults, and kittens) varied by model structure, ranging from 3.7 lions/100 km^2 (95% CI=3.6, 5.7) from a base model (including an effect of distance on detection probability) to 6.7 lions/100 km^2 (95% CI=3.1, 11.0) from a full model (including effects of distance, sex, survey effort, and distance x sex on detection probability).

Proffitt et al. (2015) also gathered genetic samples from lions one winter in a 2,625 km^2 area spanning two lion management units in Montana. They treed and biopsy darted lions to genotype individuals to estimate abundance using spatial capture-recapture models and predicted habitat use as a covariate. They estimated median density of independent lions (i.e., adults and subadults only) from 4.5 lions/100 km^2 (95% CI= 2.9-7.7) to 5.2 lions/100 km^2 (95% CI=3.4, 9.1). In northeastern Washington, biopsy dart sampling of the population when integrated with hunter harvest data was able to detect a population decline across multiple years that was noted in independent mark-recapture efforts in the same research area (Beausoleil et al. 2016). Wyoming and South Dakota have applied this technique for estimating annual lion abundance. Their experience suggests that it can be effective if a

sufficiently high number of marks and recaptures can be obtained on a multi-year basis (Daniel Thompson, Wyoming Game and Fish, personal communication 2015).

Davidson et al. (2014) surveyed a 220 km^2 area with scat detection dogs over a 4-week period in Oregon. The dogs found lion scats that were used in DNA analysis to genotype individuals. Individual capture histories were used in 4 capture-recapture models to estimate total lion abundance. Density estimates including all lions (adults, subadults, and kittens) were: 4.6 lions/100 km^2 (95% CI=3.8, 8.3) for the Huggins model, 4.8 lions/100 km^2 (95% CI=4.2, 7.8) for the Multiple Detection Poisson model, 4.2 lions/100 km^2 (95% CI=3.3, 5.3) for the CAPWIRE model, and 5.0 lions/100 km^2 (95% CI=3.2, 7.7) for the Spatially Explicit Capture-Recapture model.

Colorado Parks and Wildlife research staff have been experimenting with a non-invasive mark-resight population sampling method that holds promise for abundance estimation (Mat Alldredge, CPW, personal communication 2020). Initial work demonstrates that results are valid, have acceptable confidence intervals on estimates, and can be conducted at a reasonable cost. Therefore, this mark-resight methodology using "marked" GPS-collared lions and remote game cameras is currently being implemented on a management scale as part of CPW's Upper Arkansas research project. This technique can provide reference densities in a variety of locations with diverse habitat quality and also will allow testing of resource selection function models. This non-invasive approach uses a call to lure lions to a site where a game camera records photos of the animal. A portion of the lion population in the study area is "marked" with GPS radiocollars before the camera deployment, so both capture probabilities and rigorous density estimates are obtained (Mat Alldredge, CPW, personal communication 2020).

This recent advances in Colorado using the spatially-explicit method described above will be fundamental in generating site-specific abundance or density estimates. Given the importance of numerical density assumptions in the existing resource selection function model, CPW commits to conducting robust estimates of density in multiple survey areas of western Colorado. These will be used in addition to existing estimates from recent Colorado research to further align and improve our understanding of lion populations in the state.

Helicopter-Based Track Probability Sampling: This method involves detecting and following lion tracks in ideal snow conditions along transects from a low-flying helicopter to estimate lion numbers. It is intended for general lion management purposes in representative areas, but still requires field validation for estimator precision. Results of this approach applied to lions in the wild have been reported twice in the literature and with mixed results. Field operations and data quality (i.e., bias) are limited by the difficulty in meeting conditions to observe lion tracks from a helicopter, including: 1-2 nights after snowfall with no wind to cover tracks or crust snow, dense vegetation canopy, helicopter availability, and avoidance of unstable weather and physical obstacles that makes such low-flying dangerous (Van Sickle and Lindzey 1991, Anderson 2003, Choate et al. 2006). One study in Utah used this method in one survey and reported an accurate but imprecise lion population estimate when compared to a

reference population (i.e., 14.2 ± 6.3 standard error, Van Sickle and Lindzey 1991). In another Utah study, investigators observed poor accuracy, poor precision, and inconsistent biases. Some estimates of the lion population were grossly overestimated by 120 to 284% (using the Becker 1991 method) and exhibited poor precision with standard errors of 25 to 55% of the reference density (Choate et al. 2006). Adjusted population estimates using Anderson's (2003) correction for low movement lengths derived from computer simulations resulted in underestimates of 26 to 88% of the reference population. In addition, the application of Anderson's (2003) modification using random track lengths resulted in inconsistent biases of ±22-59% of the reference population (Choate et al. 2006).

Ground-Based Track Surveys: This method is intended for use as a trend indicator in representative areas for general lion management purposes. Track surveys have been used to monitor lion populations in California (Smallwood 1994, Smallwood and Fitzhugh 1995) and Arizona (Cunningham et al. 1995). This method requires transect sampling areas where lion tracks are detectable and provides presence-absence data with confidence interval estimates. Beier and Cunningham (1996) reported that sampling 140 and 110 8-km-long transects would be required to detect 30% and 50% population declines, respectively (80% power, $\alpha = 0.05$). The difficulty in implementing track surveys is ensuring that transects are well distributed throughout the population in areas where access may be limited and also the unpredictability of favorable tracking conditions. The level of effort required to detect useful population changes likely limits the application of this method to once every few to several years. Researchers in Utah applied summer track surveys and found statistically significant relationships ($P<0.03$) between winter lion density and summer-time track-finding frequency (i.e., no. track sets/km searched). The investigators concluded that ground-based track surveys are the least expensive and might be the most efficient method, and offered 2 suggestions for improvement. First, winter track counts would be more efficient than summer track counts because the tracking substrate is superior and should increase track detection rates. Second, because removal of lions during a hunting season may bias survey results, track surveys should be conducted prior to a hunting season to more closely relate the index to the population of interest (Choate et al. 2006).

Photographic Rates as an Index to Lion Abundance: Photographic rates of mountain lions might provide a noninvasive index for assessing trends in lion abundance. Such an approach has been used with tigers and showed camera days per tiger photo correlates with independent estimates of tiger density (Carbone et al. 2001). In addition, photographic rates (i.e., leopard photos/100 trap-nights) were an index to snow leopard abundance (McCarthy et al. 2008). This method has yet to be fully evaluated for lions, where individual identification without the use of "marks" is not possible as lions don't possess uniquely identifying coats or spotting patterns.

Harvest Data

Harvest data pertains to information gathered on hunter-killed lions and hunters by the managing agency. Methods based on these data are intended for general lion management as an indicator of population trends.

Relationships of Lion Harvest to Population Abundance: Researchers in Wyoming developed and validated this method on an experimentally manipulated reference lion population (Anderson and Lindzey 2005). The researchers found that the sex and age composition of the harvest varied predictably with lion population size because the likelihood of a specific sex or age class of lion being harvested (with the use of hounds) was a product of the relative abundance of particular sex and age classes in the population and their relative vulnerability to harvest. Wolfe et al. (2015) revealed other potentially useful indices to abundance. The percent of permits filled and the minimum abundance index were positively correlated. The percent of individuals in the harvest >6 years old was positively correlated with annual survival, annual adult male survival, and annual female survival. There was a negative relationship between the annual number of female lions in the harvest and annual lion survival rate. Likewise, there was a negative relationship between the annual proportion of females in the harvest and annual lion survival rate.

Catch-Per-Unit Effort: Researchers in Utah quantified catch-per-unit-effort (CPUE) of their research teams and hunters for each year as the number of days to capture a lion. In each case, they found that CPUE was a poor predictor of lion population size (Choate et al. 2006). However using a data set over a longer period of time, Wolfe et al. (2016) found a strong relationship between the number of cougars treed per day during the pursuit season and the index of minimum annual lion abundance.

Colorado West Slope Mountain Lion Management Plan
APPENDIX B

MOUNTAIN LION MANAGEMENT HISTORY IN COLORADO AND THE WEST SLOPE

Historical Management, Game Damage and Conflicts: This section provides a description of the history of lion management in Colorado. This appendix also provides a review of recent game damage and human-lion conflict information.

Mountain Lion Management History

Lion management throughout the range of this species is challenging because of the secretive nature and naturally low densities typical of this solitary large carnivore, and the rugged terrain it typically inhabits. Consequently, no statewide "census" of lion populations has ever been attempted in Colorado or the West Slope. Lion research in Colorado has focused on relatively small geographic areas involving population segments where intensive, expensive studies have revealed information for reference values on abundance, sex and age structure, fecundity, survival, mortality factors, predation, depredation, behavioral patterns, movements, dispersal, and effects of sport-hunting. Current research in the Upper Arkansas study area on Colorado's Eastern Slope using newly validated techniques will provide data types described previously, but at much larger scales and with the ability to draw more rigorous conclusions due to the strengths of the study design.

Agencies charged with lion management attempt to address the desires of the public, whose values vary and sometimes compete between maintaining abundant populations, providing hunting opportunity, and minimizing the potential for human-lion conflicts. Lions have been classified as a big game species since 1965 in Colorado. Prior to 2000, Colorado had not formulated any plans for lion management. In 1999, the Executive Director of the Department of Natural Resources (DNR) formed the Predator Management Advisory Committee, for the purpose of providing policy advice to DNR and its subordinate agency, Colorado Parks and Wildlife (CPW). This group helped develop brief plans that set annual hunter harvest and total mortality objectives based on the preceding 3-year average levels in 25 distinct geographic areas called Data Analysis Units (DAUs). By 2003 these plans were deemed too generic, inflexible and lacking a credible basis. During 2004, a new planning effort was completed producing 19 separate DAU plans for the state. This more comprehensive planning effort provided statewide direction and management sideboards related to habitat models, population extrapolations, and mortality off-take rates. The plans mentioned game damage caused by lions and human conflicts associated with lions, but management objectives were firmly focused on supportable mortality amounts.

The long-term increase in Colorado's lion population likely resulted from a combination of regulating human-caused mortality of lions since 1965 and increases in mule deer and elk populations. Consequently, lion harvest limit allocations and the amount of harvest have increased since 1980 (Figures. 1) both across the state and in more recent years in the two West Slope Regions (Figures 2 and 3). The 2004 DAU management plans and analysis suggested that similar

harvest could be obtained with substantially lower harvest limits. An emphasis of these plans was to reduce hunter harvest of females in select DAUs. Therefore, in 2007 a mandatory lion hunter education course was instituted to help increase the focus of harvest on male lions. As a result, female lion harvest composition declined and the combined effect of the reduced harvest limits and the emphasis on reducing female mortality caused an initial decrease in the total amount of hunter harvest. Recent research has revealed the importance of focusing on adult female harvest composition, as opposed to the overall female harvest mortality. The compositional monitoring threshold incorporated in this West Slope Mountain Lion Management Plan focuses on adult female proportions versus the total female proportion that was previously a standard objective in the 2004 lion DAU management plans.

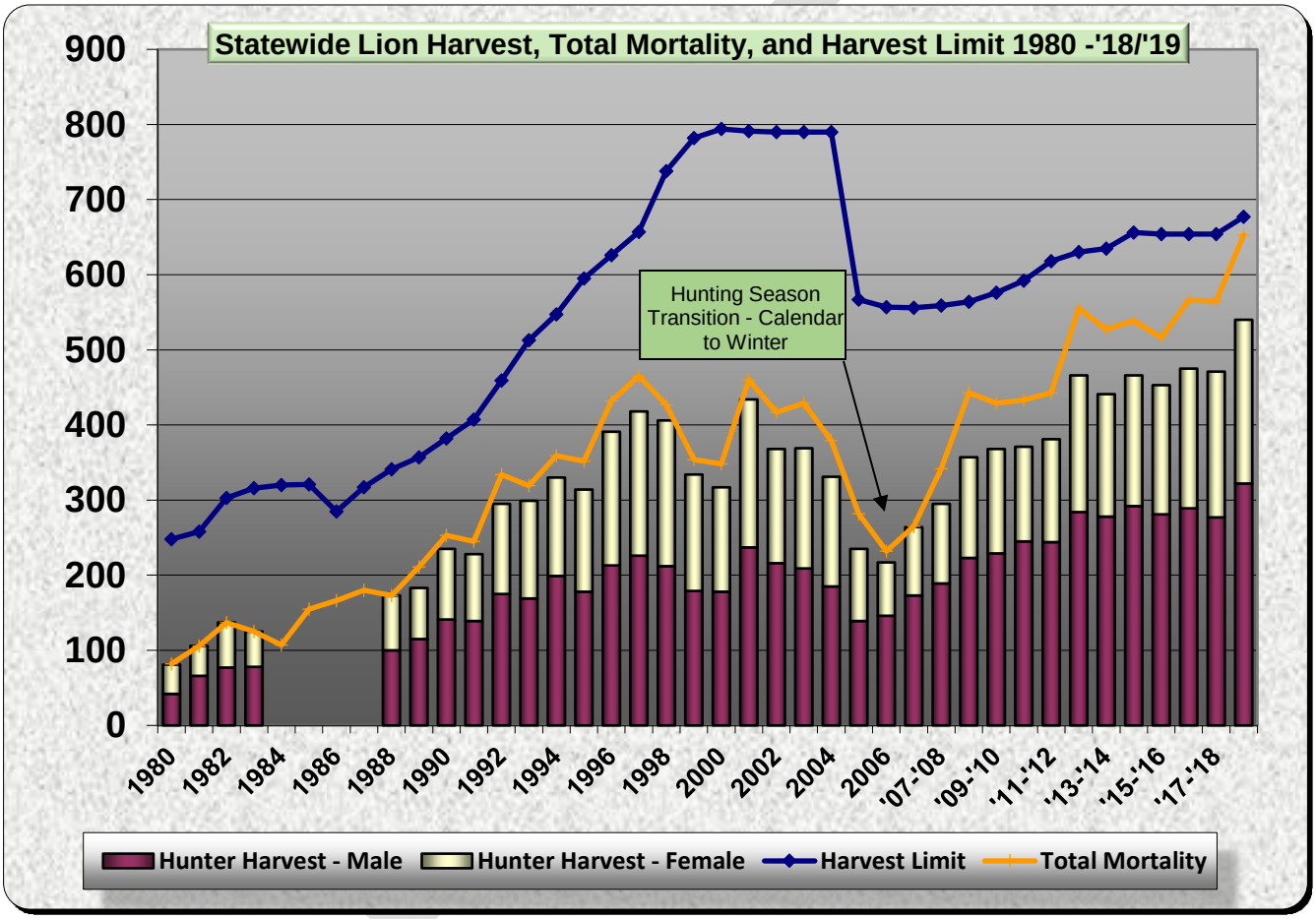

Figure 1. Annual mountain lion harvest by gender, total mortality, and total harvest limit in Colorado from 1980-2018. Note transition from calendar year to winter year in 2007.

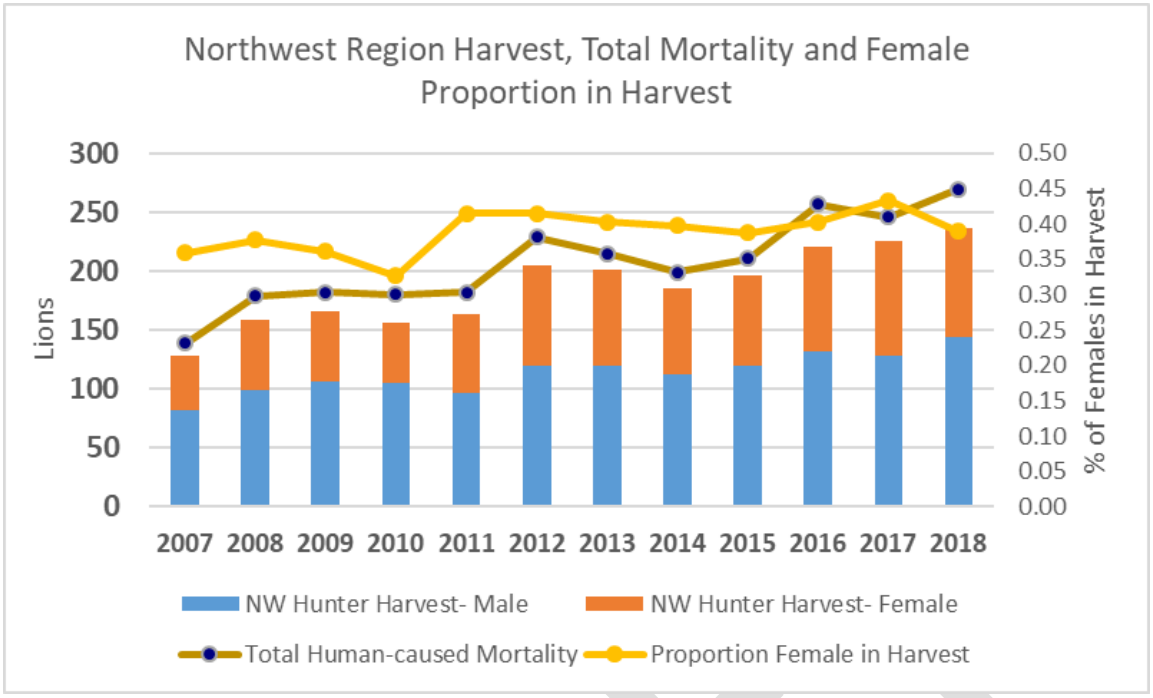

Figure 2. Historic Northwest Region harvest by gender, total mortality and proportion of females (adult and subadult) in harvest. This includes all historic GMUs in the NW Region, including those now in the Glenwood SMA.

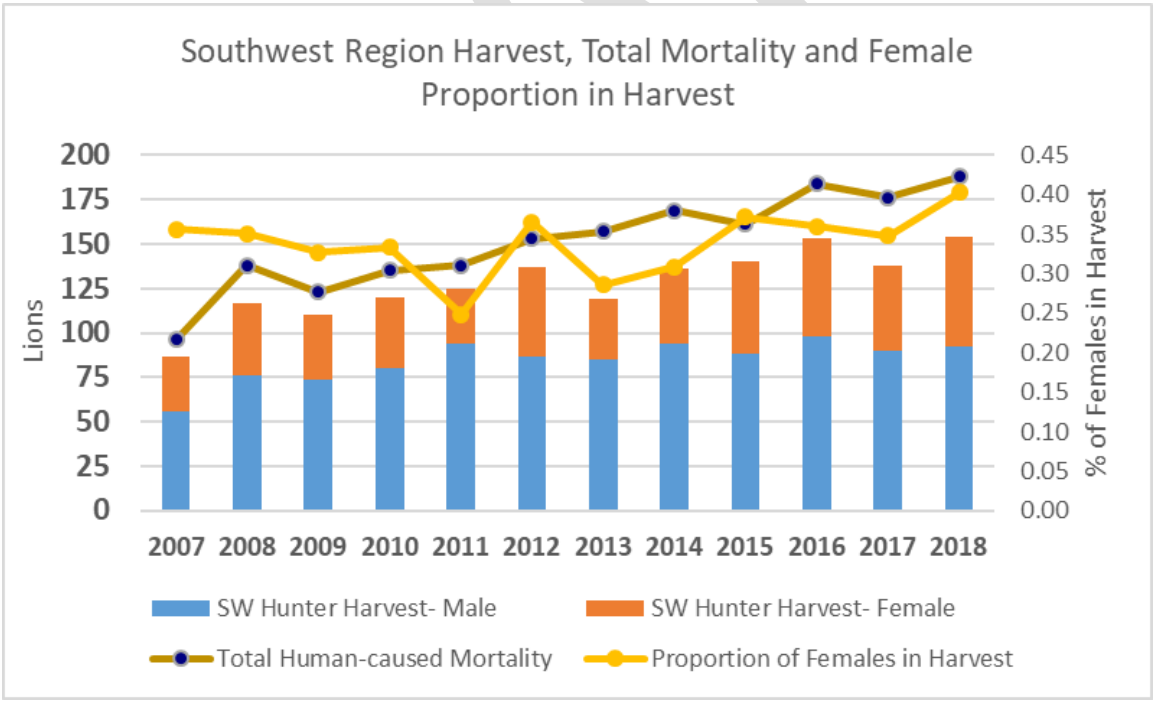

Figure 3. Historic Southwest Region harvest by gender, total mortality and proportion of females (adult and subadult) in harvest.

Non-harvest, human-caused mortality has also increased statewide since the late 1980s (Figure 1) and in more recent years on the West Slope (Figures 2 and 3). Some have attributed this to increasing lion populations. However during the past 30+ years the human population, related

development, volume of automobile traffic, and the amount of outdoor recreation in Colorado have also increased considerably. It is likely that a combination of factors contribute to the increases in non-harvest lion mortality, including better documentation of these forms of mortality in more recent decades.

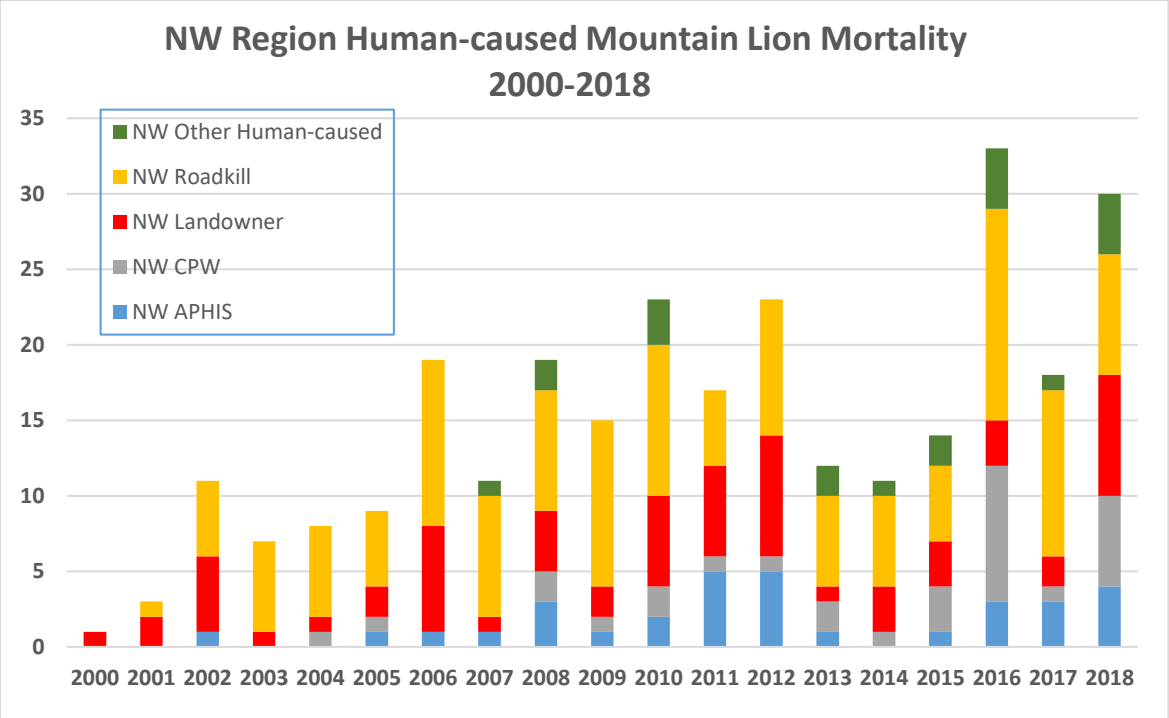

Figure 4. Non-harvest human-caused mountain lion mortality in the Northwest Region from 2000-2018.

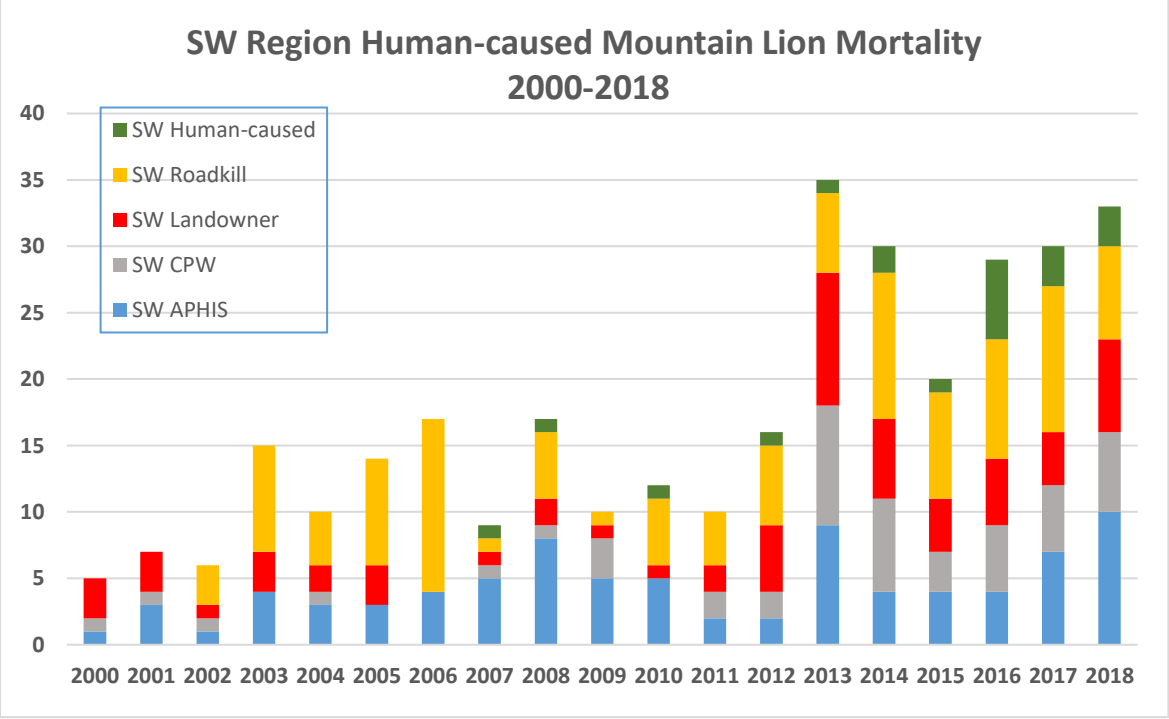

Figure 5. Non-harvest human-caused mountain lion mortality in the Southwest Region from 2000-2018.

The 2004 lion DAU management plans were based on a series of assumptions about lion population size and the population responses to varying levels of mortality. The plans noted that information about how populations actually responded to these assumptions was lacking, as was the ability to collect valid information that could detect population changes in a timely and effective manner. This led to implementation of two long-term research projects in Colorado designed to evaluate lion management assumptions, inform management decisions, and quantify actual population responses to management actions. On the Uncompahgre Plateau, research activities were completed in 2014. Subsequent data analysis and evaluation have concluded, and CPW Technical Publication Number 54 reports final project findings which are incorporated into this plan (Logan and Runge 2020). On the northern Front Range, research has concluded on estimating abundance, diet composition, and age class from non-invasive sampling. Additionally, this research evaluated lion demographic and behavioral characteristics in a significantly human altered environment. Colorado Parks and Wildlife is currently in the third year of a 9-year lion research project in the Upper Arkansas area of southeastern Colorado. This project will build knowledge of predator-prey dynamics, improved density estimates, evaluate lion population composition structure under different harvest regimes and shed light on the relationship of human-lion conflicts under varying lion harvest and abundance scenarios. Within this plan, provisions are made to allow for future periodic evaluation and updating so that the plan can incorporate knowledge gained from this and other research that may be conducted in the future.

Harvest Management

Regulation of hunting for lions in the western states typically follows 1 of 3 harvest strategies including general seasons, limited entry, and harvest limit/quota systems (CMGWG 2005).

1) General seasons allow unlimited hunting of lions of either sex, and the only restrictions include the number of licenses issued and/or bag limit allowed per hunter (typically 1 per season), and timing and length of the hunting season. General seasons provide the highest hunting opportunity, but likely result in uneven hunting pressure (i.e., accessible areas are heavily hunted and inaccessible areas are not), which limits control over the amount, composition, and distribution of the harvest.

2) Limited entry programs restrict the number of hunters per hunt area through a limited license allocation, using either first come first serve or lottery license sales. This approach is most restrictive in terms of hunter opportunity, but can be useful to disperse hunting pressure, control harvest levels, and may increase the opportunity for hunters to be selective (increasing male harvest) in areas where hunting pressure is low.

3) Harvest limit/quota management limits the total harvest and/or number of female lions harvested from defined areas. The hunting season closes in an area once the harvest limit has been met. Hunters are required to monitor status of the hunting season by checking a website prior to hunting to determine if an area is open or closed to hunting. Advantages to this approach are that hunting opportunity remains high and the amount and distribution of harvest can be regulated. Potential disadvantages of harvest limit/quota management include the number of hunters per hunt area is unlimited until harvest limits are filled and desired harvest

may be exceeded if more than 1 lion is harvested the same day the limit is reached. Also, a high amount of competition among hunters/outfitters for the lions available under the harvest limit can result in decreased harvest selection, increasing the amount of females in harvest.

Female sub-quotas can be used to support a management objective of maintaining harvest levels with reduced impact on the lion population. Advantages include the ability to stop harvest based on a female objective, while problems include illegal non-reporting of harvested females to avoid closing units and sacrificing hunter opportunity to pursue males once the smaller female sub-quota is achieved.

Colorado has managed lion hunting recreation with a harvest limit or quota system since before 1980. As originally conceived, the "quota" is the maximum amount of harvest allowable within a specific geographic area. Once the "quota" is met, the hunting season for that area is closed for that year. Lion hunting licenses are available in unlimited numbers, but hunters must check an online harvest limit report to determine if the harvest limit group of game management units (GMUs) they wish to hunt remains open to hunting. The harvest limit/quota system optimizes hunting opportunity while limiting hunting harvest to acceptable levels on an annual basis. In most DAUs in Colorado, historic "quotas" have historically been set higher than actual harvest objectives, because the full quota may not be achieved each year. This has occurred because of several factors: hunting conditions are not always conducive to harvest, the behavior of hound hunters not filling the quota to facilitate the opportunity to pursue lions and train their dogs throughout the entire season, and in some areas the constraints of guided hunts as the primary mechanism to obtain harvest. Using the name "harvest limit" instead of "quota" gives a more accurate description of how this term functions within a harvest limit group.

Historic "quotas" in Colorado have not been synonymous with the harvest objective, though the term has been mistakenly believed to be one and the same. When quotas went unfilled it created an erroneous perception for some that management was failing to achieve the desired harvest. The upper end of harvest objectives and the total mortality limits codified in the 2004 lion DAU management plans were intended to be the maximum amount of acceptable annual mortality; a value not to be exceeded. The contrast of perception and intention surrounding these terms has contributed to some of the debate about lion management today.

In 2013, an April lion season (April 1-30) was implemented to provide hunting opportunity in locations where harvest objectives were not being achieved during the regular season. In these areas, an additional season provides extra hunting opportunity and hunter harvest within the previous lion DAU management plan objectives. In its original design, the April season was intended to be a simple extension of the existing lion season structure. The "regular" lion season opens after the last day of the 4th deer and elk season; typically around the middle of November through March 31. However, because Colorado's license year is April 1 – March 31, administrative and logistical requirements resulted in establishment of a regular and an April season harvest limit, which has caused confusion in when, where, and why seasons would be open in April and what the objectives would be. Prior to 2019, CPW used the 3-year running average of residual harvest limit from the regular season and set that amount on an annual basis as the harvest limit for the April season in order to function as an extension of the regular season. Harvest during 2016-2018 April

seasons averaged less than 10 lions in each year. Beginning in 2019, to more efficiently manage the lion regulatory cycle and remove confusion over how April harvest limits were set, CPW combined the numeric harvest limits from the April season and regular season into one single annual harvest limit.

All hunter harvest of lions must be reported as part of a mandatory check process required in some form since before 1980. In 1989, the agency included a requirement that all discovered non-hunt mortality must also be documented through the mandatory check process. Data collected at the mandatory check include: harvest date, location (legal description, Universal Transverse Mercator location, and hunt area), sex, lactation history (whether or not females have ever nursed young based on nipple characteristics; Anderson and Lindzey 2000), estimated age from tooth wear and degree of staining, collection of teeth for cementum annuli aging, number of days spent hunting, and hunting method. Trainer and Golly (1992) reported 76% agreement ≤1 year of annuli ages compared using blind tests of 2 premolars from the same lion (n = 426; 92% agreement for lions <4 years old), and annuli age comparisons of known age lions were 95% accurate (within 1 year; Trainer and Golly 1992, Anderson 2003). In 2019, the recording system used for these mortality reports was overhauled and data are now collected on a computer or mobile application as opposed to a paper form.

This mandatory reporting system is the most accurate way of accounting for human-caused mortality, so while time consuming for staff to implement, it attains quality data. Lion carcasses or pelts harvested by hunters may be frozen, which can reduce the collection of teeth or the ability to inspect evidence of the gender. Washington noted that hound hunters correctly determined the gender of lions at bay about 70% (57-88%) of the time, whereas agency personnel correctly determined the gender of lions during mandatory checks 87% (71-90%) of the time (Beausoleil and Warheit 2014). They recommended better training of agency staff and education with hunters to improve the credibility of data that is important to management purposes. In Colorado, hunter education on gender identification is part of the mandatory mountain lion hunter education course. Agency staff is trained annually on the data collection process from mandatory inspections. In addition to mortality data, CPW compiles data on human-lion conflicts and game damage claims, and gauges social concerns through public meetings, contacts with the public, hunter surveys, and public attitude surveys.

Methods of Mountain Lion Hunting

Lion hunting in Colorado is accomplished primarily by tracking and baying lions using trained hunting dogs (i.e., hunting with hounds). However, during lion seasons, harvest may also occur through opportunistic encounters (spot and stalk) or by calling lions using predator calls (mouth calls). The majority of lions harvested annually in Colorado are taken by hunting with hounds (typically >95%). Compared to 20-35 years ago, recent advancements in technologies has dramatically changed the manner of guided hound hunting, which is the primary way most lions are harvested in Colorado. Collar technology on pursuit hounds allow an outfitter to release hounds and track them on a computer or hand held GPS device. Collars may be equipped to detect when the dogs have a lion at bay. This allows for examination of the closest or easiest path for the hunter and guide to approach the bayed lion without actually engaging in foot pursuit from the

release of hounds to the point of bay. All-terrain vehicles (ATVs), snowmobiles, cell phones, and digital radios all combine to make hound hunting lions more efficient than in past decades.

Some groups and individuals are concerned about the use of dogs as a hunting method for lions, and some states have banned hunting with hounds (e.g., Oregon, Washington). In 2005, CPW hired Corona Research to survey attitudes of Coloradans about issues related to lions. Some key elements related to lion hunting include: a) An overwhelming majority of Coloradans thought it was important for lions to exist, even if they never saw one, and it was important for them and future generations to have lions; b) Coloradans were split about hunting lions, with 47 percent in support of legal and regulated hunting and 41 percent opposed; and c) 46 percent disagreed that lion hunting should be banned, while 34 percent agreed with a ban. These results provide a broader representation of attitudes of Coloradans about lion conservation and hunting, well beyond the traditional constituents that agency personnel more frequently contact during the process of structuring hunting management. As we recommend in the Research Needs portion of the planning document, a more updated survey in the near future would be useful to evaluate if those sentiments reported above have changed among citizens.

In states where hunting with hounds has been prohibited, opportunistic lion hunting (during big game seasons or predator calling) is capable of obtaining similar or higher harvest levels as before the bans. States in which lion hunting with hounds has been prohibited typically compensate for substantially decreased success rates by reducing the price of a license, increasing the number of licenses, and easing mechanisms by which licenses can be obtained. Results from Washington (Martorello and Beausoleil 2003) revealed that opportunistic lion hunting is less selective of sex and age class than hunting with hounds and female lions are more vulnerable to harvest from opportunistic hunting than from hound hunting. Relative female harvest levels increased from 42% to 59% when hunting with hounds was banned in Washington (mean annual harvest before hound hunting ban = 157 and after hound hunting ban = 199). In Oregon, similar increases in the proportion of females in harvest were observed, and within 7 years, total harvest amounts regularly exceeded harvest amounts prior to the ban on hound hunting (Don Whittaker, Oregon Dept. of Fish and Wildlife, personal communication 2015).

Lion harvest data from Colorado suggest that hunters using the services of an outfitter are more selective in the harvest of females (36% F) than hunters not using an outfitter (44% F). In comparing the methods of hunting lions in Colorado, the use of hounds appears to improve hunter selectivity regarding females (37% F hound hunters compared with 55% F for opportunistic hunting). This suggests that applying mechanisms to expand hunting seasons absent the use of hounds is likely to result in an increase in the absolute amount of and composition of females in harvest. In addition, if opportunistic hunting harvest increased and hunting with hounds was reduced, we would expect an increase in the number of dependent young being orphaned due to hunting because of the apparent increased vulnerability and the higher proportion of females harvested with non-selective methods (Martorello and Beausoleil 2003).

Differences in the composition and amount of females in hunter harvest are likely a combination of a hunter's ability to determine gender (while a lion is treed or at bay), but are also related to differences in lion vulnerability between hunting methods. Anderson (2003) observed that nightly

movement distances from GPS data averaged over 3 times longer for male lions than for females (mean end-point distance = 4.6 km versus 1.5 km, 2.9 mi versus 0.9 mi). These longer distance movements expose males more than females to hunting methods where tracking is involved (i.e., hunting with hounds). Opportunistic hunters who do not track lions while hunting are more likely to harvest the more abundant sex, typically females, because relative abundance and chance encounters drives harvest vulnerability.

Mountain Lion Conflicts

There are two broad categories of human-lion conflicts: game damage and human safety. Game damage primarily refers to the economic costs of lion depredation on domestic livestock. Human safety primarily refers to the concerns about and the real or perceived risks to human safety that may be posed by lions. State law provides allowance for the public to kill a lion that is considered a threat to people's safety or to livestock [*Colorado Revised Statute §33-3-106(3): Nothing in this section shall make it unlawful to trap, kill, or otherwise dispose of bears, mountain lions, or dogs without a permit in situations when it is necessary to prevent them from inflicting death, damage, or injury to livestock, real property, a motor vehicle, or human life*]. Animals killed under the authority of this provision must still be reported within 5 days of its death to CPW and the state of Colorado retains legal possession of such animals; consequently, CPW is able to obtain information on the number of such losses. If lions are killed in the summer and/or in remote locations or are too badly decomposed, obtaining gender or tooth samples is difficult and less data are generally collected on such animals.

The broadest tool CPW uses regularly to address mountain lion conflicts is public education. Providing the public educational resources will continue to be a prominent agency tool under the West Slope lion plan. Education is done both proactively, as a staple when the staff interact with the public in lion habitat or on lion-related issues, and reactively in contacts with the public after a specific human-lion conflict. There are a number of pamphlets, brochures, videos and educational tools that CPW produces to educate the public on actions they can take to reduce human-lion conflicts. These steps include improved animal husbandry practices for livestock producers, employing guard animals and removing vegetation from near homes that attract deer and elk or provide cover for lions. This agency education also focuses on how to recreate in lion habitat and steps to take if you encounter a lion. Temporary signage is often used to inform the public about areas where lions have been recently seen to further educate about the need to take commonsense precautions, particularly with pets and children in these areas.

Immediate agency responses to game damage and human safety conflicts in Colorado are primarily aimed at individual animals involved in the conflict. The actions that can be applied to an individual lion involved in either conflict behavior are broad and are usually determined on a case-by-case basis. Intervention techniques include capture and translocation, lethal removal, and on-site hazing. Hazing can involve harassment with trained dogs and non-lethal projectiles fired at the animal. This does not preclude the agency from applying larger scale management efforts to address such conflicts. Colorado Parks and Wildlife previously identified 2 West Slope management areas in which the objective was increased harvest to suppress the lion population (DAUs L-7 and L-9). Figure 6 shows the location of current mountain lion DAUs in Colorado.

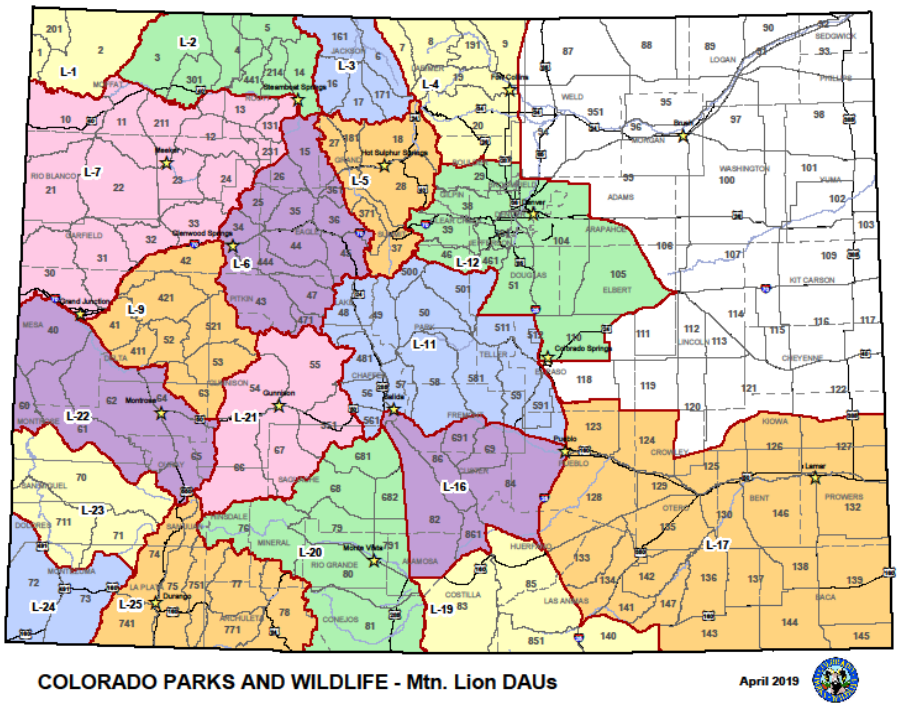

Figure 6. Current mountain lion Data Analysis Units for 2020 season.

Some recent research suggests that management targeting an area for increased harvest (rather than an individual conflict animal) may not be effective because of rapid immigration from adjacent source populations (Robinson et al. 2008, Cooley et al. 2009*b*). These authors postulate that it is possible that the increased presence of younger immigrant animals, social disruption of lion populations, and spatial changes in use patterns of immigrants that result from increased harvest may all contribute to increases in human conflicts and game damage (Peebles et al. 2013). A correlative study in British Columbia found that when accounting for human density and habitat productivity, harvest levels comprised the most correlated variable to conflict numbers (Teichman et al. 2016). Unfortunately, this study did not account for underlying lion densities, which could strongly relate to harvest levels and defined conflict in very broad terms, including roadkill, livestock depredation and perceived risks from sightings. Similar to Peebles et al. (2013) the authors of this study looked at the relationship between conflicts and mortality at very large scales and collapsed data from large spatial scales for purposes of the analysis.

In contrast, an Oregon lion population study found an inverse relationship between conflict lion mortalities and lion harvest (Hiller et al. 2015). The authors present an analysis showing that under high lion population densities, the number of lions killed due to livestock conflicts decreased as harvest density increased. Their results indicated that hunter harvest may be a useful tool in managing livestock conflicts in circumstances when agency managers can increase prey populations, increase hunter harvest on lions, and reduce vulnerability of livestock. To date, the scientific evidence regarding the effectiveness of population scale management to effect reductions in conflicts is equivocal. In fact, data from Colorado do not suggest a relationship between high lion harvest and increased conflicts, but rather just the opposite. Areas of highest harvest removal as

shown in Figure 2 of the West Slope Lion Management Plan document do not correlate with highest non-agricultural conflicts and many areas of high conflict in Colorado have, in fact, very little or no harvest.

Laundre and Papouchis (2020) used the example of California, a state without a legal lion hunting season, to test various assumptions that some might make about the role harvest plays in managing conflict, depredations and deer numbers. As in some other studies, the issue of scale of analysis is important. Pooling data on lion population size, human population size, conflicts and harvest across entire states for comparison, as done in this study, ignores other significant differences between states, and more importantly, does not account for context of those data categories within each state. Research in Colorado regarding the effects of harvest and lion population density suggest management to reduce conflict has varied results and is not solely linked to harvest. Few, if any studies, have been able to look at the value of small-scale, localized harvest or agency removals of lions involved in human-lion conflicts, and then make conclusions about that impact on quantifiable reporting of human-lion conflicts. Monitoring goals in the Glenwood SMA, should allow evaluation of the full suite of management tools and their efficacy in reducing conflicts. Both the ongoing research project in the Upper Arkansas area and the proposal for the Glenwood SMA are manipulative treatments, and as such, will allow stronger inferences on relationships between harvest and overall mortality to conflict levels.

Game Damage

Colorado has been liable for monetary losses caused by lions to livestock since the 1920s. However, it wasn't until the 1970s that game damage laws and liability were first codified in statute. Liability for damage caused by wildlife is governed by Colorado Revised Statute §33-3-103. Regulations that establish the process for submitting a claim and the process whereby a stock producer can prove their claim and value of the stock were first established in the mid-1970s. Consequently, CPW has a long history of damage payments related to lion depredation on livestock. However, records were not accurately maintained regarding claim numbers, location, dates, and amounts until the 1990s.

In 1996 the Colorado Department of Agriculture (CDA) was granted "exclusive jurisdiction over the control of depredating animals that pose a threat to an agricultural product or resource." Thus, CDA has exclusive authority to determine the disposition of an individual lion if it is depredating on livestock, while the CPW retains authority to manage lion populations, body parts, and all forms of recreational or scientific use. A Memorandum of Agreement between the CDA and CPW provides operational guidance for both agencies. This aids both agencies in implementing their management authority and helps assure documentation of agriculture-related lion deaths and the legal disposition of carcasses. As a matter of policy, any lion that is involved in a depredation incident shall be destroyed if it can be captured or identified.

In 2002, the Colorado legislature limited the State's liability for damage caused by lions to livestock or personal property used in the production of raw agricultural products and further limited liability to not more than $5,000 per head of livestock. As a consequence of this change, non-agricultural personal property claim payments have been eliminated.

Over the last 15 years on the West Slope, the annual number of lion damage claims submitted to CPW has ranged from 18 to 65. In the 5 most recent years, claims have averaged 44 per year. Domestic sheep depredation accounts for the largest share of monetary compensation paid annually over the past 5 years, averaging just over 50% of all claim payments on the West Slope (Figure 6 and Table 1). Other stock account for just over 40% of annual claim payments over the past 5 years, but involve relatively few numbers of animals, outside of goats (Table 1). The exotic stock classification includes llama, alpaca, guanaco, angora goats, and other livestock that typically are considered hobby stock animals. Because they are often highly valuable, damage claim amounts for exotic stock are often higher on a per claim basis compared to other livestock. The total monetary amount of damage paid on Colorado's West Slope has been less than $100,000 in 14 of the last 15 years (Figure. 6). Using the last 15 years of data, West Slope lion damage payments average less than $61,000 per year; during the most recent 5 years damage payments have averaged $65,000 per year.

Nearly two thirds of all lion game damage occurs from May through September. This largely coincides with the time that domestic sheep are on Bureau of Land Management and United States Forest Service summer grazing allotments and may also be the time that hobby stock are more commonly allowed to remain outside at night instead of held within barns as during winter months. On open range and even in pastures outside of homes, stock such as sheep or hobby animals would be more vulnerable to lion depredation during milder seasons.

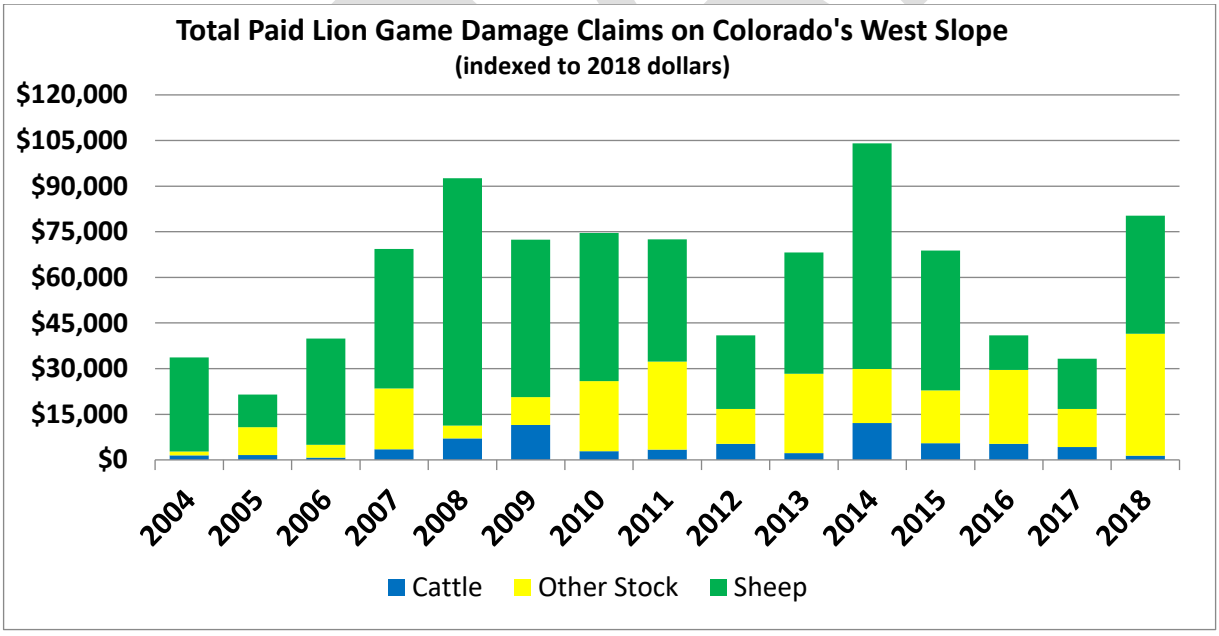

Figure 6. West Slope compensation paid for mountain lion damage in Colorado from 2004 through 2018.

Table 1. Number of animals submitted in mountain lion damage claims to CPW from 2004-2018 by Region and animal type.

REGION		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Northwest	Captive Wildlife	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
	Cattle	1	1	0	3	5	8	4	3	2	0	4	5	1	2	2
	Exotic Stock	0	0	2	1	0	0	1	0	1	0	3	0	3	0	5
	Goats	0	0	0	11	8	1	29	15	4	4	0	8	6	3	29
	Horses	0	1	0	0	0	1	1	1	0	1	0	0	1	0	2
	Other Animals	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
	Poultry	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0
	Sheep	132	26	126	192	333	279	116	111	35	84	197	155	17	5	127
	Swine	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
	Grand Total	**133**	**28**	**128**	**207**	**347**	**289**	**151**	**153**	**42**	**89**	**204**	**168**	**30**	**10**	**168**
Southwest	Captive Wildlife	0	0	0	1	0	3	0	1	0	0	3	1	3	0	0
	Cattle	1	2	0	1	5	9	2	2	2	11	4	0	1	2	1
	Exotic Stock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Goats	5	15		36	3	13	12	16	48	24	32	20	40	20	45
	Horses	0	2	1	2	0	0	1	1	0	5	0	0	0	0	0
	Other Animals	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
	Poultry	0	0	0	25	0	9	6	60	27	0	30	74	0	35	62
	Sheep	33	27	15	50	89	101	63	17	68	86	68	40	9	42	47
	Swine	0	0	0	12	2	0	0	3	0	1	0	0	2	0	6
	Grand Total	**39**	**46**	**16**	**127**	**99**	**135**	**84**	**101**	**146**	**127**	**137**	**135**	**55**	**99**	**161**

Human Safety

Lion attacks on humans across North America are rare, but their frequency has increased in recent decades (Beier 1991, Torres et al. 1996, CMGWG 2005). This has also been found in Colorado. Lion attacks on humans occur primarily in the summer season (June-August), which likely correlates with the amount of outdoor recreation activity that occurs in Colorado lion habitat (Figure. 7). Mattson et al. (2011) evaluated 386 human-lion encounters, including 29 fatal and 171 non-fatal injury attacks on humans, documented in the U.S. and Canada to determine the important risk factors in such encounters. They found that young females (≤2.5 years) were more likely to be involved in an attack on people than adult lions. Their examinations show that attacks on people are extraordinarily low-frequency, but high consequence events that are difficult to anticipate or prevent. They noted that aggressive behavior (yelling, throwing objects, charging, or discharging firearms) by people involved in close encounters with lions lessens the likelihood that the lion will attack. Unfortunately, several states have documented their first fatal human attacks over the last several years.

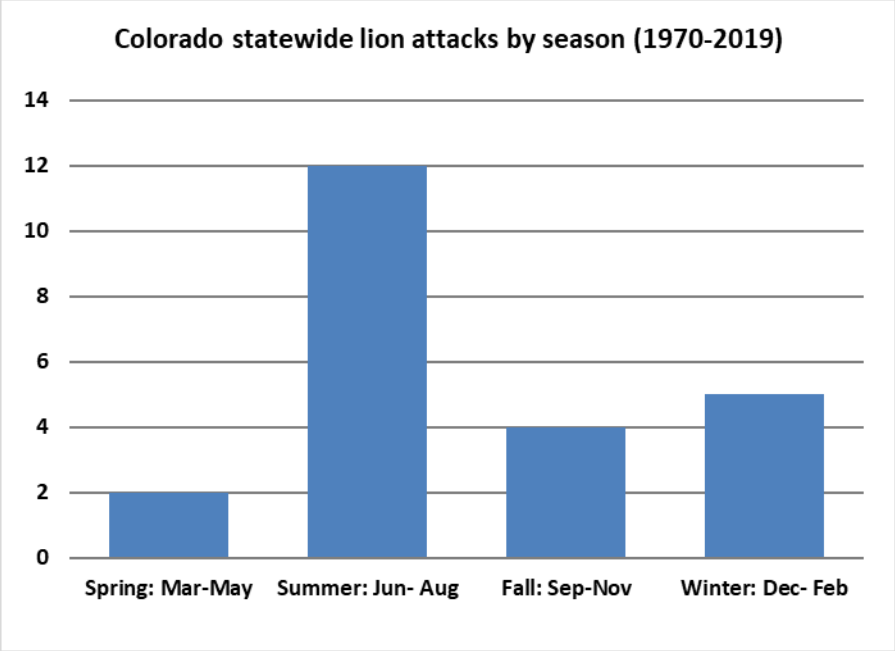

Figure 7. Seasonality of mountain lion attacks on humans in Colorado.

CPW Administrative Directive W-20 Human-Mountain Lion Interactions, establishes the agency procedures for dealing with general conflicts that may develop between humans and lions. This policy directs that agency management responses to a specific conflict between people and a lion or lions will be directed at the individual lion(s) involved and not at the population management scale. Administrative Directive OW-2 Predator Attacks on Human(s), details the manner in which the agency will respond to an attack by a lion (and any other predator) on a person. Both of these administrative directives allow for lion relocation under certain circumstances and provide direction for when that may happen. However, it is also the policy of CPW per these administrative directives that a lion will be euthanized when it's determined to be dangerous because of its behavior, whereas a lion that is dangerous because

of its location may be euthanized or relocated. The determination on relative risk due to location or behavior presented by the individual lion will be made by the Regional staff involved with addressing the incident.

Per these administrative directives, CPW employees are required to document human-lion conflicts via a conflict recording system. Lions lethally removed under Administrative Directive W-20 will be recorded as such on the conflict report. These reports document essential information about the date, time, location, type of conflict, number of people, and animals involved, and the circumstances of the conflict. Along with the mortality recording system, this human-lion conflict recording system was overhauled in April 2019 to provide an electronic recording system that is consistent, standardized and used across the state to record each human-lion interaction reported to CPW. Due to the previous recording system using hardcopy paper forms across the state to record incidents, developing historically accurate precise enumerations of conflicts is difficult. The new web and mobile-based application currently in use is expected to provide much more consistent and precise data.

Two separate public opinion surveys in Colorado have revealed that the majority of Colorado citizens prefer that the agency apply non-lethal conflict management tools, except in the case of attacks on people (Zinn and Manfredo 1996, Corona Research 2005). However, when considering the location of an attack on a person, respondents equivocate; 49% opposed destroying a lion involved in an attack if the person was recreating in lion habitat (Corona Research 2005). These results and those previously mentioned regarding public opinions about lion hunting suggest that the public is quite divided in their perspectives about lions. Nevertheless, the Corona survey indicates that the public strongly supports active management of lions as well as encouraging responsible behavior by people to manage human-lion conflicts.

Colorado West Slope Mountain Lion Management Plan
APPENDIX C

Mountain Lion Resource Selection Function Model

Colorado Parks and Wildlife (CPW) modeled lion winter habitat using a resource selection function (RSF) approach, which compares where species are present to habitat that is available in the landscape. The winter period is defined as December-February and all lion locations used in our model correspond to those dates. We used 2,470 male and 1,603 female mortality locations documented through mandatory checks from 2000-2013 as our presence sample in the model. We created a list of 18 variables considered important to how lions choose habitat in Colorado (Table 1). We then removed variables that were highly correlated with each other, like distance to deer and elk winter range. This resulted in 6 variables chosen for model development, including distance to mule deer winter range, elevation, low vegetation, short shrub, tall shrub, and slope (highlighted in Table 1). We generated an equal number of random locations (n= 4,100) within lion habitat documented within CPWs species activity maps (http://gisweb/webmaps/sam/sam.html) and used these as the "available" sample.

Table 1. Variables originally considered for development of the 2020 Colorado winter mountain lion habitat resource selection function (RSF) model.

Variable	Keep or Remove	Why Removed
NE aspect	Remove	Correlation with another aspect
SE aspect	Remove	Correlation with another aspect
SW aspect	Remove	Correlation with another aspect
NW aspect	Remove	Correlation with another aspect
Distance to mule deer winter range	Keep	
Distance to elk winter range	Remove	Correlation with mule deer distance
Distance to bighorn winter range	Remove	No contribution to model
Elevation	Keep	
Urban	Remove	Less than 1% of landscape
Suburban	Remove	Less than 1% of landscape
Bare	Remove	Less than 1% of landscape
Low vegetation	Keep	
Short shrub	Keep	
Tall shrub	Keep	
Forest	Remove	Correlated with elevation and TRI
Water	Remove	Less than 1% of landscape
Slope	Keep	
TRI (roughness)	Remove	Correlated with slope and elevation

Using ArcMap 10.1 (ArcGIS 10.1; Environmental Systems Research Institute, Redlands, CA), a continuous predictive surface was created that represented the relative probability of lion presence in winter across Colorado. However, with a goal of projecting a potential lion abundance across the West Slope, a probability of lion presence surface has limited practical use. Harvest rates and mortality thresholds are based on projections of lion numbers or population projections, so we needed to take steps to convert from relative probability of lion presence into projected lion abundance. Therefore, we elected to stratify the prediction

surface into 4 categories: strata 1 was where the probability of lion winter presence = 1-25%, strata 2 probability of lion winter presence 26-50%, strata 3 probability 51-75%, strata 4 probability 76-100% (Figure 1).

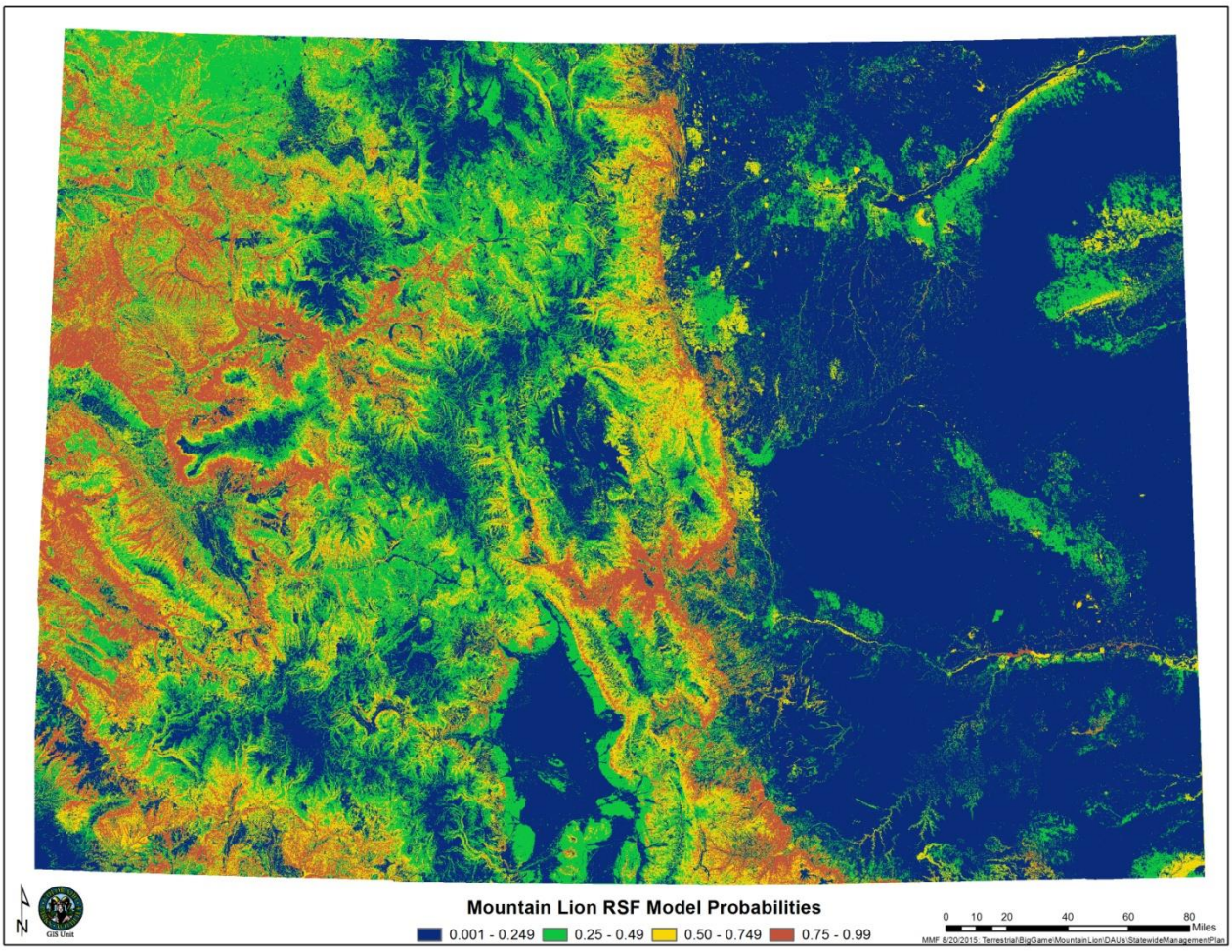

Figure 1. Modeled mountain lion winter habitat with the probability of presence stratified into four categories of increasing probability.

In a final step, three independent datasets were used for model validation: 164 winter lion predation sites on mule deer documented through CPW mule deer survival monitoring, 14,793 GPS locations from 33 female and 9 male lions researched on the Uncompahgre Plateau from 2004-2015, and 58,593 GPS locations from 45 female and 32 male lions researched in the Northern Front Range west of Denver-Longmont, CO from 2007-2015. For each validation set, we assigned each validation point to one of the 4 categories of the relative probability surface and determined the percentage of those points that were within the two highest stratas which correspond to > 50% relative probability of presence. We found that 86% of the Uncompahgre GPS locations were within stratas 3 and 4 of our model, 82% of northern Front Range GPS locations were within stratas 3 and 4, and 73% of the deer predation sites were within stratas 3 and 4.

Results from the modeling effort indicate that lions are closer to mule deer winter range, at lower elevations, within steeper slopes, and within tall shrub habitats compared to the habitat available. Lions were less likely to be located within low vegetation or short shrub habitats compared to the habitat available in the landscape.

We stratified the model results into 4 strata related to the probability of lion presence in winter. We assumed that lions exist in greater density in strata with high probability of presence and assigned decreasingly lower densities in the two strata with lower probability of winter lion occurrence. The top two strata of the RSF model represent "high quality" winter lion habitat for the purposes of the West Slope management plan source population analysis.

There are several alternate approaches to deriving a lion abundance index extrapolation. One would be to assume that at some low level of habitat selection probability these areas are functionally not lion habitat; or, alternatively predetermine that some portions of Colorado are not winter habitat and exclude them from the model. Then one has to assign some assumed density smoothed over the remaining area. This approach has two problems; there will always be some debate about what is excluded and if a lion is ever observed in excluded habitat then the model is deemed a failure. Applying some even density in all the remaining habitat fails at regional scales because it is likely to result in too many lions in low probability locations (e.g. eastern plains areas or high altitudes) and too few in high probability locations (e.g. deer winter range, in tall shrubland/forested areas, with high topographic relief). Another approach is to apply a continuous range of lion density from near zero to some upper limit which corresponds with the RSF model prediction surface of 0.2% to 99.7%. The challenge with this approach is selecting what the lower and upper density should be and this seemed no better than the stratification approach that we selected.

We calculated the amount of habitat by strata in each of the monitoring scales (NW and SW Regions (Table 2)). Ultimately, we applied assumed independent lion densities to each stratum to generate an extrapolated abundance index from which we calculated 17% to determine the maximum Regional total human-caused mortality thresholds presented in the West Slope plan. An interdisciplinary team of managers and biologists in CPW examined lion densities reported in literature (Table 1 in Appendix A) and considered habitat quality, prey base, abundance of alternative prey, vegetation characteristics, and the RSF model outputs.

The winter-range independent lion densities listed below and applied in each strata were selected based on observed lion densities in the literature (Table 1, Appendix A) with particular weight given to density estimates from the most recent study in Colorado (Alldredge et al. 2019), and projects that used more modern and rigorous estimation methods including mark-recapture (Proffitt et al. 2015, Beausoleil et al. 2016). These newer techniques estimate capture probabilities and address study area closure while past methods of radio-collaring what was assumed to be all the lions in a study area could never account for these issues and were less statistically robust. As part of the West Slope plan, CPW will begin

to conduct mark-resight lion density surveys in representative habitats in western Colorado to allow further refinement of RSF assumptions, densities and projections.

The following densities were applied to each RSF stratum:

Strata 1: 1.0 independent lions/100 km^2. This strata represents lower-quality winter-range. While some lower lion density is documented in these areas from harvest and other mortality locations as well as visual observations, lion use is low and densities are well below average levels from studies in better habitat.
Strata 2: 2.5 independent lions/100 km^2. This strata represents a mid-level quality of habitat where lion densities are expected to exist in moderate numbers due to variables like slope, elevation and distance to deer winter range. This is the largest strata, in terms of area, on the West Slope.
Strata 3 and Strata 4: 4.2 independent lions/100 km^2. These two strata represent better lion habitat on the West Slope and as such, each represent a relatively small portion of each Region. Prey densities are very high in these strata as they largely include deer winter range and high-quality habitat. The relatively high density applied in these strata is supported by recent work in quality lion habitat both in Colorado (4.1 independent lions/100 km^2, Alldredge et al. 2019) and in other western Rocky Mountain states (4.5-5.2 independent lions/100 km^2, Proffitt et al. 2015).

The NW and SW cumulative Region-wide average independent lion densities generated from the RSF after strata densities were applied **are 2.9 lions/100 km^2 and 2.6 lions/100 km^2,** respectively. This range of 2.6-2.9 independent lions/100 km^2 as an extrapolated density across all of the West Slope is strongly supported by numerous studies reporting lion densities. Viewing lion densities as a numeric range is important, as point estimates from lion density studies are often the focus for management applications, but these values should be evaluated in the context of the variability shown by the confidence intervals.

Any GMU or landscape on the West Slope has contributions from all 4 strata and therefore will always have a ***total projected density well below the density of 4.2 lions applied in only the highest quality habitat***. The independent lion densities derived from this extrapolation process in 12 GMUs in Colorado, which represent a range of medium to high winter lion habitat quality, mostly ranged from 2.5 to 3.5 lions/100 km^2; a few were as low as 2.2 lions/100 km^2 and one was 3.8 lions/100 km^2. As expected from any model, some projected RSF densities are higher and some are lower than empirically-derived densities in study areas of the same geographic area. However, when evaluated across all GMUs in each region, the average densities of independent lions projected from the RSF are supported by Colorado projects and densities from similar habitats in other states (see Table 1 in Appendix A). For instance, Alldredge et al. (2019) documented a density of 4.1 lions/100 km^2 in a study area on the Front Range, while the RSF extrapolation density in the GMU encompassing the study area only projected a density of 2.6 lions/100 km^2.

An RSF model provides a temporal snapshot of what populations could be using densities and model variables applied at that time. That is why a commitment to obtain temporally and spatially relevant density estimates throughout the duration of the West Slope plan is important. An even more comprehensive modeling approach could be considered by developing an Integrated Population Model (IPM) for lions on the West Slope or Colorado. Given that Regional lion populations likely are best modeled at a statewide level, our future intention to revise Front Range lion plans, and the current limitations on West Slope demographic data needed to populate an IPM, we believe an IPM could become a useful tool in later years but only after we have obtained density estimates and ancillary data from radio-collared animals.

Table 2. Amount of area (in km^2) within each strata, delineated by existing DAUs on the West Slope. Only the portions of the existing DAUs that are within each Region are displayed.

REGION	*LIONDAU*	*Strata 1 W of I-25*	*Strata 2*	*Strata 3*	*Strata 4*
	L-1 Total	60	2389	1000	599
NW	L-2 Total	1957	4073	1068	193
	L-22 Total	80	426	588	833
	L-3 Total	2121	1848	220	3
	L-5 Total	1688	3447	1008	44
	L-6 Total	2476	3974	2428	1506
	L-7 Total	2644	5888	5613	6912
	L-9 Total	630	956	865	1369
NW Total		11655	23000	12791	11460
	L-16 Total	1441	749	492	137
SW	L-19 Total	1179	1423	564	74
	L-20 Total	6695	4771	1663	358
	L-21 Total	2836	4661	1662	137
	L-22 Total	1306	2238	2791	2679
	L-23 Total	1452	2157	1929	1850
	L-24 Total	1705	1156	1042	943
	L-25 Total	2880	3034	2610	1511
	L-9 Total	868	1490	1175	1046
SW Total		20363	21679	13929	8734

Colorado West Slope Mountain Lion Management Plan
APPENDIX D

LITERATURE CITED AND REFERENCES

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Colorado West Slope Mountain Lion Management Plan
APPENDIX E

WEST SLOPE MOUNTAIN LION PLAN PUBLIC PROCESS AND RESULTS

Summary of Outreach Efforts

The West Slope Mountain Lion Management Plan went through an extensive public outreach process, which was designed to inform the public of the proposed plan and collect input. Our outreach included a series of in person public meetings, a Facebook premier event, the posting of the plan on the CPW website for a 6 week review period, and outreach to local governments and interest groups. A list and timeline of these outreach efforts can be found in Table 1.

Outreach for the draft plan began in January of 2020 with 12 in-person public meetings hosted by CPW across the Western Slope. Approximately 584 individuals attended the in-person presentations. The audiences were encouraged to complete surveys after the session. Surveys from the West Slope meetings were completed by 360 members of the public.

Three in-person public meetings were planned on the Front Range; however, COVID-19 gathering limitations prevented these meetings from occurring. Therefore, to reach broader audiences geographically, CPW hosted a Facebook Premier event on April 16, 2020. The Facebook Premier event featured a pre-recorded presentation that was consistent with the presentation given at West Slope in-person meetings and a recorded question and answer session. The question and answer recording was developed from common themes identified during the West Slope public meeting process. Staff remained online to engage with viewers for a 5-hour window after the video premiered. Over 32,000 views were recorded in the first twenty-two hours of the video being posted.

The draft management plan and associated appendices were posted to the CPW mountain lion webpage on March 12, 2020 for public review. The formal public comment period opened on CPW's website on March 12, 2020 and closed at midnight on April 30, 2020 (~ 6 weeks). CPW's standard for posting draft management plans on the web is 30 days, but this extended posting was offered to ensure that the draft plan was available to review and comment after the Facebook Premier event occurred. During the draft plan review period, 1,855 formal public comments were received. Of the formal comments from within Colorado, 80% were associated with zip codes from the East Slope and 20% from the West Slope.

The formal public comment period also made accommodations for communities and individuals who do not use the internet by providing the option for those communities to submit their feedback via paper forms. CPW made direct outreach contacts to Boards of County Commissioners, the Habitat Partnership Program, federal agencies, and other stakeholder groups from January through April 2020. In total, seven press releases were produced by CPW Public Information Officers to highlight all public input opportunities. The

cumulative press releases were successfully delivered 4,081 times to media outlets and public members who signed up to receive CPW press releases directly.

Table 1. Stakeholder Outreach Efforts

	Location or Audience	Description	Notes
1/9/2020	Mesa County Board of County Commissioners	Proposal Discussion	USFS Grand Mesa Ranger District, USFS Rifle Ranger District, BLM Grand Junction Field Office Present
1/20/2020	Colorado Cattlemen's Association	Proposal Discussion	Reid DeWalt spoke at the mid-winter convention
2/1/2020	USFS Holy Cross & Sopris Ranger Districts	Proposal Discussion	
2/1/2020	BLM Lower Colorado River Office	Proposal Discussion	
2/10/2020	Steamboat Springs	West Slope Public Meeting	
2/10/2020	Gunnison	West Slope Public Meeting	
2/11/2020	Kremmling	West Slope Public Meeting	
2/11/2020	Norwood	West Slope Public Meeting	
2/12/2020	Glenwood Springs	West Slope Public Meeting	
2/13/2020	Delta	West Slope Public Meeting	
2/18/2020	Gypsum	West Slope Public Meeting	
2/19/2020	Meeker	West Slope Public Meeting	
2/19/2020	Grand Junction	West Slope Public Meeting	BLM Grand Junction Field Office staff present
2/20/2020	Rifle	West Slope Public Meeting	
2/20/2020	Durango	West Slope Public Meeting	
2/20/2020	Grand Mesa Habitat Partnership Program Committee	Proposal Discussion	
2/21/2020	Alamosa	West Slope Public Meeting	
3/1/2020	Garfield County Board of County Commissioners	Requests for Discussions	Several requests were sent in March & April
3/4/2020	BLM Grand Junction Field Office	Coordination Meeting - Proposal Discussion	CPW & proposed plan listed as an agenda item
3/23/2020	Summit County Board of County Commissioners	Emailed Press Release & Public Comment Period Info	Emailed reminder of comment period close on 4/28/2020
3/23/2020	Grand County Board of County Commissioners	Emailed Press Release & Public Comment Period Info	Emailed reminder of comment period close on 4/28/2020
3/23/2020	BLM Kremmling Field Office	Emailed Press Release & Public Comment Period Info	
3/23/2020	USFS	Emailed Press Release & Public Comment Period Info	Verifying which offices Lyle contacted

3/25/2020	BLM Grand Junction & Silt Field Offices	CPW Formally Requested Input	
3/25/2020	USFS Grand Mesa & Rifle Ranger Districts	CPW Formally Requested Input	
4/3/2020	Virtual meeting with special interest groups that included Humane Society of the United States, Wild Earth Guardians, and the Sierra Club	Meeting was to discuss the contents of the draft plan and take feedback from these groups. The groups followed with a formal comment letter.	
4/8/2020	Montezuma County BOCC	Email with link to plan and requesting input	
4/8/2020	Backcountry Hunters and Anglers-SW Colorado	Email with link to plan and requesting input	
4/8/2020	Southwest Livestock Growers Association	Email with link to plan and requesting input	
4/8/2020	San Juan Citizens Alliance	Email with link to plan and requesting input	
4/8/2020	La Plata County Living with Wildlife Advisory Board	Email with link to plan and requesting input	
4/10/2020	Montrose County BOCC	email plan and invite to Facebook event	Email presented plan to BOCC and asked to reach out with comments or concerns
4/14/2020	Eagle County Board of County Commissioners	Proposal Presentation	
4/14/2020	Pitkin County Board of County Commissioners	Proposal Presentation	
4/14/2020	BLM Kremmling Field Office	Proposal Discussion	Personal call to Bill Mills
4/14/2020	La Plata County Living with Wildlife Advisory Board	Proposal Discussion	
4/16/2020	Facebook Event	Online Proposal Presentation, Live Q&A	Replaced front range meetings due to COVID19
4/21/2020	Colorado Outfitters Association	Email with link to plan and requesting input	All mailing list
4/21/2020	USFS Aspen-Sopris Ranger District	Proposal Discussion	
4/22/2020	Mesa County Board of County Commissioners	Proposal Presentation	
4/22/2020	USFS Sulphur Ranger District	Coordination Meeting - Proposal Discussion	
4/22/2020	La Plata County BOCC	Discussion with BOCC	
4/23/2020	BLM Kremmling Field Office	Proposal Discussion	Personal call to Bill Mills
4/27/2020	Hinsdale, Mineral, Rio Grande, Alamosa, Costilla, Conejos and Saguache Board of County Commissioners	Emailed Links to all relevant information along with a reminder to comment and provide support letters.	

4/27/2020	USFS Divide Ranger District	Emailed Links to all relevant information along with a reminder to comment and provide support letters.	
4/27/2020	BLM San Luis Valley Field Office	Emailed Links to all relevant information along with a reminder to comment and provide support letters.	
4/27/2020	San Luis Valley Ecosystem Council	Emailed Links to all relevant information along with a reminder to comment and provide support letters.	
4/27/2020	Gunnison Board of County Commissioners Chair	Phone discussion on lion management plan and support	Personal call with Jonathan Houck-BOCC supports CPW as wildlife mgmt professionals in CO
4/27/2020	Hinsdale County Board of County Commissioners	Email exchange with BOCC chair	
4/27/2020	Gunnison Wildlife Association	Phone discussion on lion mgmt plan and support	Call with GWA President Cody Dyce, they will submit letter of support
4/27/2020	Dolores County Board of County Commissioners	Emailed Links to all relevant information along with a reminder to comment and provide support letters.	
4/27/2020	Archuleta County Board of County Commissioners	Emailed Links to all relevant information along with a reminder to comment and provide support letters.	

West Slope Public Meeting Details

Beginning in February 2020, CPW hosted twelve in-person public meetings across the West Slope. Over 584 individuals attended these meetings. A PowerPoint presentation was given at each meeting, after which CPW answered questions and circulated a survey to capture feedback. A total of 360 surveys were submitted at the end of the discussions across all meetings. Attendees who provided usable email addresses were provided a follow-up email when the formal comment period opened online. The most commonly asked questions answered by staff in these in-person meetings are listed below.

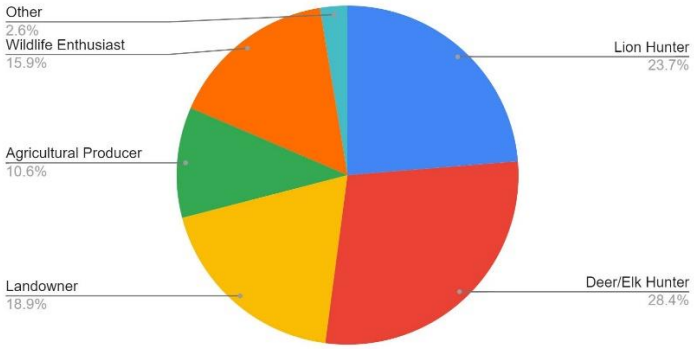
1. How was the percent adult female threshold determined? Why only adult females?
2. Why is a female sub-quota not recommended in this plan?
3. Why aren't gender-specific lion tags issued?
4. Will pursuit tags ever be available?
5. Will private land vouchers be considered, that don't contribute to hunter harvest?
6. What if the population estimates projected by the Resource Selection Function are not accurate?
7. Is the current population ideal for maintaining at a stable level?
8. With these larger Harvest Limit Groups, aren't wildlife managers concerned that specific game management units may experience over-harvest or under-harvest?
9. Is CPW aware of the British Columbia & Washington peer-reviewed mountain lion research papers that describe social chaos in hunted mountain lion populations?
10. Why aren't non-lethal methods used to manage problem mountain lions?

West Slope Public Meeting Survey & Results

The five questions posed on the survey, with results, are as follows.

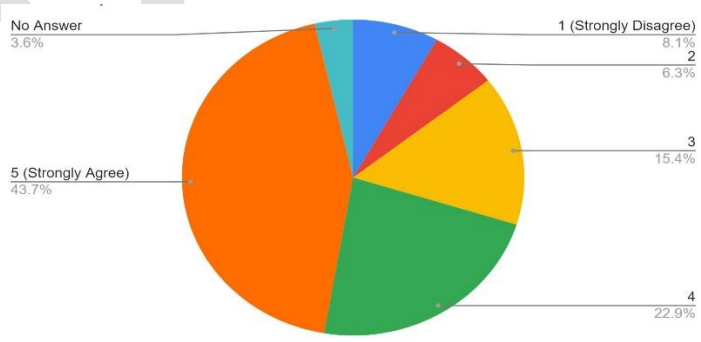
1. How do you interact with mountain lions? Choose your primary interest.
    a. Lion Hunter
    b. Deer/Elk Hunter
    c. Landowner
    d. Agricultural Producers
    e. Wildlife Enthusiast
    f. Other: _____

Figure 1. Proportion of Responses to Survey Question 1



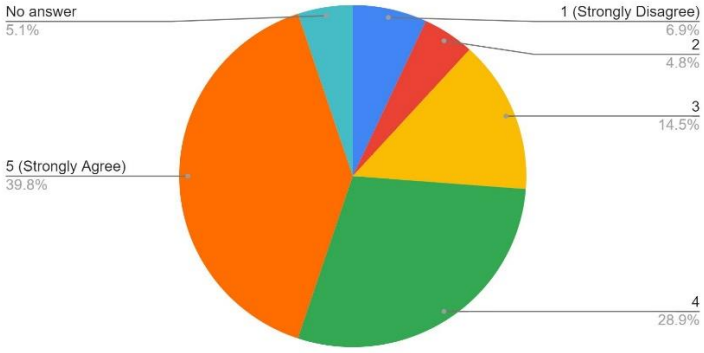
2. Managing mountain lions on a landscape scale is appropriate for the species.
    a. Scale of 1-5. 1: Strongly Disagree 5: Strongly Agree

Figure 2. Proportion of Responses to Survey Question 2



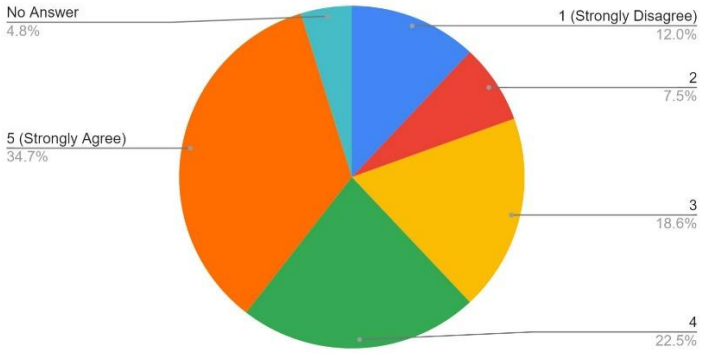
3. This plan allows wildlife managers more flexibility to manage lions.
    a. Scale of 1-5. 1: Strongly Disagree 5: Strongly Agree.

Figure 3. Proportion of Responses to Survey Question 3



4. This plan allocates harvest limits to meet local needs while maintaining a stable mountain lion population across the West Slope of Colorado.
    a. Scale of 1-5. 1: Strongly Disagree 5: Strongly Agree

Figure 4. Proportion of Responses to Survey Question 4



5. Do you have any comments or concerns on mountain lion management to relay to wildlife managers?
    a. Open for written responses.

Facebook Premier Event Details
CPW's Facebook Premier went live on April 16, 2020, at 3 p.m. Colorado Parks and Wildlife staff pre-recorded the same presentation provided to West Slope Public Meeting attendees along with responses to common questions identified from the West Slope meetings. After the event premiered at 3 p.m., staff were available until 8 p.m. for live responses to all comments with questions pertaining to mountain lion management. This event was hosted in lieu of in-person Front Range meetings (which were canceled due to COVID-19 gathering restrictions).

Analytics of the Facebook Premier event were evaluated when the video had been posted for twenty-two hours. In total, 3,767 engagements with the materials were recorded. A total of 427 comments were on the post at hour twenty-two, which included the responses from CPW.

Formal Online Public Comment Period Details
The draft West Slope Mountain Lion Management Plan and Appendices were posted to the CPW lion webpage on March 12, 2020 for formal comments and closed at midnight on April 30, 2020. A Google Form was used to capture all comments. Each respondent's zip code was a required component for all comments. No formal questions were asked of those that had reviewed the plan; space was provided for open-ended feedback on elements of the management plan. A total of 1,855 comments were submitted during this review period.

The public comment period garnered worldwide attention. The intent of this comment period was to collect input on elements of the proposed West Slope Mountain Lion Plan. Many of the comments received did not comment on the plan itself; rather, they were philosophical comments about the ethics of mountain lion hunting. Mountain lion hunting in Colorado is regulated per Chapter W-02, Article VI of CPW's Regulations. The question of whether or not hunting mountain lions in Colorado should continue was not posed to the public and should be addressed through other channels. Comments to this effect were put into the "N/A" category. Some comments did mention specific lion plan elements while expressing that the commenter was against mountain lion hunting; these comments were included in the comment statistics & common themes below.

Comment Statistics

- 35% of the online comments either had no text attached, were incoherent, or did not relate to the management plan itself
- Of the comments associated with Colorado zip codes, approximately 80% were from the East Slope
- Of the comments associated with Colorado zip codes, approximately 20% were from the West Slope

Approximately 14% of the online public review comments had "form letter" elements identified, which indicates that the proposed management plan came to their attention through a mailing list with prompts, or was cut and pasted from a common source.

Common Themes

CPW staff examined all of these comments to identify commonality between comments and general themes. The top themes are listed below. Of additional note was the widespread request for robust mountain lion community education programs. The word "education" was mentioned 128 times in comments received.

1. Not Applicable, Incoherent, or blank: 652 comments or 35%
2. Form elements identified (indicating the comment period came to their attention through a mailing list): 259 comments or 14%
3. Against trophy hunting, against mountain lion hunting, or against all hunting: 475 comments or 25%
4. Against suppression or mountain lions, against harvest increases, or against the Glenwood Springs SMA: 406 comments or 22%
5. Against the use of electronic calls: 323 comments or 17%
6. Against April mountain lion harvest, concurrent seasons, or extended seasons: 184 comments or 10%
7. Supportive of this plan & lion hunting: 139 comments or 7%
8. Supportive of increased mountain lion harvest, mountain lion population reduction, or the Glenwood Springs SMA: 61 comments or 3%
9. Requested more research on mountain lions on the West Slope of Colorado: 101 comments or 5%

Analysis of Public Feedback

Feedback from the in-person West Slope public meetings contrasted with the feedback received during the online comment period. A range of stakeholders attended the in-person meetings outside of the sportsmen community; 16% identified as primarily "wildlife enthusiasts" over options including hunters, agricultural producers, or others. The West Slope Public Meeting section provides an analysis of audience identification and complete percentages of survey answers compiled. More than half of all attendees agreed or strongly agreed with the following statements:

1. Managing mountain lions on a landscape scale is appropriate for the species. (57% agree & strongly agree)
2. This plan allows wildlife managers more flexibility to manage lions. (69% agree & strongly agree)
3. This plan allocates harvest limits to meet local needs while maintaining a stable mountain lion population across the West Slope of Colorado. (67% agree & strongly agree)

Of the 1,855 comments received during the formal online comment period, 318 were from zip codes associated with West Slope addresses (living within the proposed management plan boundary). A total of 1,324 comments were from zip codes associated with East Slope addresses and an additional 213 comments were either out of state or invalid for mapping (perhaps submitted incorrectly and some comments in this category were international).

Sociological differences were detected based on the location of the commenter. Those who don't live within the plan boundary tended toward protectionist mindsets. Those who live with the mountain lions that are managed within this plan boundary offered different feedback that generally trended toward a management mindset.

Local Support for the Glenwood Springs Special Management Area (SMA)

While some members of the communities surrounding the Glenwood Springs SMA have expressed concerns, the majority of local opinions received regarding the management practices proposed in the Glenwood Springs SMA were supportive. The surveys circulated at the public meetings held in Glenwood Springs and Gypsum indicate that residents generally agree with the goals of this proposed lion management plan. Concepts proposed in the management of the SMA were strongly driven by input from residents and local governments that have expressed concerns both in the number and severity of human-lion conflicts in this area over the past decade. This was demonstrated and supported by the many written comments on these surveys that referenced increased human-lion interactions and the need for increased mountain lion management efforts. Letters of support for this special management area have been collected from individual residents, homeowner associations, Boards of County Commissioners, and stakeholder groups that focus on landscapes in or adjacent to the Glenwood Springs SMA.

CPW's Response to Public Input

During the formal comment period, some stakeholders expressed a desire for this draft plan to be peer-reviewed by a professional wildlife management agency. To accommodate this request, the draft West Slope Mountain Lion Management Plan was shared with technical staff involved with lion management and research at the Oregon Department of Fish & Wildlife. Derek Broman formally commented that "as a wildlife biologist, large carnivore manager, and representative of a state wildlife agency, I'm very pleased to see that this draft plan incorporates all relevant components of contemporary lion conservation and management." This review is included, in full, in Figure 5 on page 12 of this appendix.

Respondents also requested surveys that produced more solid mountain lion density estimates for the West Slope. In response, CPW has committed to beginning lion density surveys in 2021. Developing robust estimates of current lion density in survey areas on the West Slope will help improve and refine assumptions made in the RSF model (Appendix C). A further explanation of this proposed density monitoring approach is provided on page 36 of the draft West Slope Mountain Lion Management Plan.

The strategy proposed in the Glenwood SMA to reach of the objective of reducing human-lion conflicts was also modified to fit an adaptive management framework. Currently-proposed tools would be employed for the first half of the West Slope Mountain Lion Management Plan, followed by an evaluation. This review would assess success of management actions, including higher harvest limits, to reach objectives of reduced conflicts. However, following an adaptive management framework evaluation, if data suggest that higher harvest, along with other tools, haven't been successful in reducing conflicts, then a different management scenario will be employed after the evaluation.

CPW will also increase public education programs across West Slope communities to better educate residents who live in mountain lion habitat on how to decrease the chances of negative interactions. These educational programs will be developed through collaboration between CPW's NW & SW Region Staff, CPW's Creative Services and Marketing Department, and CPW's Education Department. The educational media & materials produced by this collaboration will be distributed to West Slope schools, boards of county commissioners, home owner associations, and other avenues as identified by the above team. Local field staff will continue to engage with communities at every opportunity (providing school programs, working with partner organizations on educational programming, etc.).

It is worth noting that mountain lion advocacy groups agreed with the metrics proposed in this plan. While the Humane Society and their partners are "generally opposed to the hunting of mountain lions in Colorado and beyond," they "support CPW's efforts to improve management of mountain lions, as well as implementing mortality thresholds, including a 17% total human-caused mortality limit and a 22% adult female mortality limit." The letter is included, in full, on page 40 of this appendix.

Figure 5. Agency Peer Review of the draft West Slope Mountain Lion Management Plan

Oregon
Kate Brown, Governor

Department of Fish and Wildlife
Wildlife Division
4034 Fairview Industrial Drive SE
Salem, OR 97302
(503) 947-6301
FAX: (503) 947-6330
Internet: www.dfw.state.or.us/

May 22, 2020

Mark Vieira
Colorado Parks and Wildlife
317 W. Prospect
Fort Collins, CO 80526

RE: Oregon Dept of Fish and Wildlife lion plan review

Hello Mark,

Thank you for the opportunity to review and provide feedback on Colorado Parks and Wildlife's West Slope Mt Lion Management Plan. As a wildlife biologist, large carnivore manager, and representative of a state wildlife agency, I'm very pleased to see that this draft plan incorporates all relevant components of contemporary lion conservation and management.

Overall, this draft plan incorporates an adaptive management approach in nearly every subject. This is important to note as the draft plan does not always state that fact but deserves credit for incorporating that vital component of transparent decision-making and successful wildlife management.

With the assistance of Dr. Darren Clark, below are answers to your questions posed.

1) Monitoring Thresholds: Do the selected upper thresholds for a stable lion population of not exceeding a 3yr average total human-caused mortality level of 17% of the extrapolated population and not to exceed a single year of more than 22% adult female proportion in harvest align with our objective? These are equal and interacting metrics that are evaluated at the Regional scale each year. In your experience as a manager and as someone familiar with the literature do you find staying below those rates to be compatible with a stable population objective?

Those numbers reflect values reported in the lion literature and are similar to values used by managers when identifying mortality thresholds. Therefore, objectives to not exceed those values indeed reflect an intent to prevent decline but allow for stability or growth. As lion populations and factors affecting human activity are quite dynamic, it is valuable to incorporate running averages (i.e. 3yr average) to account for rare or unique events outside of the norm. That being said, monitoring adult female mortality on an annual basis and establishing annual thresholds that enact a management response is logical considering the value of adult females and is a conservative approach.

2) Along that same line, do the required reductions in harvest and other steps (outreach to reduce female take) adequately support a correction in trajectory if a threshold is exceeded?

There is little empirical data to provide insight on exactly how populations will respond to those proposed reductions in female and overall harvest (i.e. through a 1% mortality threshold), but that management action is the most logical approach to addressing a downward trajectory. It is always good practice to employ an adaptive approach to evaluate the response and consider additional actions. As written, the Plan suggests a commitment to a conservative approach where populations may remain stable or increase.

Should the objective be to reach or maintain a target population level, using an adaptive management approach, adjusting mortality thresholds may need to be considered to account for those years with populations exceeding the population objective. Essentially, the current plan calls for a reduction in mortalities following a year or years exceeding established thresholds, but currently no response occurs if mortalities fall below thresholds. It should be noted that the area covered by this Plan could see any duration of lion population growth if the sum of mortalities fall below the total sum of thresholds, with no accounting for those surplus years. This again highlights the current draft Plan's conservative approach.

3) Do you have any suggestions or comments on improving the Resource Selection Function that our population extrapolation is based on? In year one, under this plan, we will initiate two lion density surveys on the West Slope using mark-resight techniques and align/adjust previous winter-range independent lion density estimates.

The RSF constructed was carried out according to literature on the technique and the use of strata is consistent with the use and interpretation of RSF products. When appropriate, we recommend clarifying that the RSF was constructed for winter habitat suitability (vs. another season or year round).

The extrapolation of density estimates across the strata is a logical approach but there are two issues that should be addressed. The first is that density estimates should ideally be derived from within those strata. It is good that density estimates will be obtained for those strata in the coming years, but until those are obtained, there will inevitably be concerns regarding the validity of the current estimates. We suspect this is likely a current area of contention. The density estimates selected for the strata fall within those from the literature but we recommend the use of contemporary values whenever possible. The techniques for detecting and monitoring secretive large carnivores has greatly advanced in the past decade, producing estimates that are far more statistically robust than past estimates that were often based on shaky assumptions such as all animals in a study area were monitored. Until those local estimates are established, a greater explanation of why the proposed strata values were selected is desired.

The second is that the population extrapolation is not that responsive to actual changes in lion populations. CPW is certainly aware of that limitation but has likely evaluated all options before ultimately settling on the use of that technique. Other options include the use of an Integrated Population Model (IPM) that is more responsive technique but is a larger commitment and effort to implement. However, the proposed technique is not without burden as new density estimates from field investigations would require adjusting population extrapolations and thresholds. We suspect CPW considered an IPM so a very brief presentation on the values and limitations of the RSF-population extrapolation technique and other (but not all) considerations would be useful.

4) Does the explanation of application of thresholds at Regional scales properly manage for stable (neither increasing or decreasing) lion populations at that scale, while also allowing flexibility at small local scales (like the Glenwood Special Management Area) to manage with additional tools to help reduce lion densities?

The use of these larger scales of regions and nested harvest limit groups is an important change from historical DAUs as the new strategy better suits the lion ecology and a source-sink framework. The draft plan (pg 9) does a good job of describing the need for this approach and the shortcomings of using areas too small for the species. The strategy to have unique management objectives for the Glenwood SMA fits within a source-sink framework.

5) As a state that doesn't have the tool of hound hunting for lions, does the explanation and rationale for the use of hounds and the underlying advantages of selectivity appear to be supported by your experience?

Yes, the lessons learned in Oregon support that rationale. See "Survival rates of cougars in Oregon from 1989 to 2011: A retrospective analysis" by Clark et al. (2014) for an evaluation of how harvest and cougar populations were impacted by the removal of hound hunting.

Please contact me with any questions.

Sincerely,

Derek Broman

Derek Broman
Carnivore-Furbearer Coordinator
Oregon Department of Fish & Wildlife
503-947-6095
derek.j.broman@state.or.us

Letters Received Independently of the Formal Public Comment Period
The letters listed below are included, in full, after Table 2.

Table 2.

Name	Region	Agency/Group/Board
USFS Rio Grande	SW	Agency
USFS Sulphur RD	NW	Agency
USFS White River NF Super.	NW	Agency
BLM NW District	NW	Agency
Mesa County BOCC	NW	Board
Montezuma County BOCC	SW	Board
La Plata County BOCC	SW	Board
Rio Blanco County BOCC	NW	Board
Archuleta County BOCC	SW	Board
Eagle County BOCC	NW	Board
Minturn Town Council	NW	Board
Red Sky Ranch HOA	NW	Board
Single Tree Property Owners Association	NW	Board
Eagle Ranch Wildlife Committee	NW	Board
Back Country Hunters & Anglers	NW	Group
RMEF - Eagle County	NW	Group
Safari Club International	N/A	Group
Human Society of the United States & Partners	N/A	Group

USDA United States Department of Agriculture | Forest Service | White River National Forest | 900 Grand Ave Glenwood Springs, CO 81601-3602

File Code: 2600
Date: April 30, 2020

Matt Yamashita
Area 8 Wildlife Manager
Colorado Parks and Wildlife
0088 Wildlife Way
Glenwood Springs, CO 81601

Dear Matt,

On behalf of White River National Forest, I would like to provide my support for the West Slope Mountain Lion Management Plan. I understand that perhaps the greatest change to management would be the structure of the units in which lions are harvested; from many small DAU's and harvest limit groups to a single DAU with harvest limits spread across a greater landscape for the Northwest Region. Across White River National Forest this equates to flexibility to allocate harvest as conditions and lion populations change.

Allowing big game hunters the opportunity to harvest lions concurrently with their fall hunt also adds flexibility to the plan.

The Glenwood Springs Special Management Area overlaps portion of the Aspen-Sopris District to include the Colorado River, the Fryingpan, Lower Roaring Fork, and Crystal River Drainages. We have anecdotal evidence supporting CPW's evidence that lion numbers are on the rise, and receive occasional reports of up-close sightings of lions from Forest visitors. I agree with the management objective to address human safety concerns by reducing human-lion conflicts in this Special Management Area.

Other elements of the plan such as allowing electronic calls and adjustments to harvest ratios of adult females seem to have no bearing on use of National Forest Lands.

As the plan is finalized in the coming weeks, I would like to point out to CPW that winter travel restrictions are in effect annually from November 23 to May 20 across the White River National Forest. During this time, wheeled travel is restricted. Winter gates on many roads are shut. Forest users are not barred from accessing the Forest, however I think there should be information provided within the plan that discloses this restriction, since the plan includes spring hunt seasons. In particular, this could influence the use of dogs as a hunting aid, which are often transported via wheeled vehicles.

Thank you for the opportunity to share my support and comment on the plan.

If you have any questions or would like to discuss further, please contact Natasha Goedert at (970) 945-3257.

Sincerely,

X SCOTT FITZWILLIAMS Digitally signed by SCOTT FITZWILLIAMS Date: 2020.04.29 14:34:13 -06'00'

SCOTT G. FITZWILLIAMS
Forest Supervisor

cc: Natasha Goedert, Elizabeth Roberts, Phil Nyland

United States Department of Agriculture | Forest Service | Rio Grande National Forest | Divide Ranger District
13308 West Highway 160
Del Norte, CO 81132
(719) 657-3321 TDD 657-6038

Date: April 28, 2020

Rick Basagoitia
Area Wildlife Manager
Colorado Parks and Wildlife

To whom it may concern:

I support Colorado Parks and Wildlife's proposed 2020 West Slope Mountain Lion Management Plan.

The draft plan puts forth a strategy to allow management flexibility at smaller geographic scales (harvest limit groups) while managing for viable and stable lion numbers at the larger Regional geographic scale. Under this new plan, the West Slope will be comprised of two Data Analysis Units, corresponding to the CPW Northwest and Southwest Administrative Regional boundaries. This West Slope plan will monitor lion populations at the CPW Administrative Region geographic scale (NW DAU and SW DAU) instead of the historic DAU scale.

The West Slope Lion Management Plan initiates a new management framework that evaluates annual lion mortality data against selected thresholds that are scientifically supportive of a stable lion population. Mountain lion harvest limit groups were delineated according to the need to distribute harvest geographically while recognizing the landscape scale of mountain lion movements.

Lion populations will be managed for a Regional objective of a stable population. This will maintain viable lion populations and sustainable harvest compatible into the future.

Mountain lions are an important species in Colorado. Their function in the ecosystem along with the recreational opportunities they provide makes them a key species for management. The proposed West Slope Mountain Lion Management Plan takes into consideration best available science, applies sound management thresholds regarding mortality, establishes monitoring methods and will help to ensure the continued sustainability of this species in Colorado.

I encourage the Colorado Parks and Wildlife Commission to adopt this plan.

Sincerely,

/s/ Dale Gomez
Dale Gomez
District Wildlife Biologist
Rio Grande National Forest

USDA United States Department of Agriculture | Forest Service | Sulphur Ranger District

9 Ten Mile Drive
P.O. Box 10
Granby, CO 80446
970-887-4100
Fax: 970-887-4102

File Code: 2620
Date: May 1, 2020

Lyle Sidener
Area Wildlife Manager
Colorado Parks & Wildlife
Area 9 - Middle Park
PO Box 216
Hot Sulphur Springs, CO 80451

Dear Mr. Sidener:

The U.S. Forest Service appreciates the opportunity to review the draft COLORADO WEST SLOPE MOUNTAIN LION (*Puma concolor*) MANAGEMENT PLAN. A primary focus of the plan is to increase the size of the management unit at which analysis and evaluation will occur, to a more appropriate scale. As under recent lion management, hunter harvest will continue to be allocated across groups of Game Management Units, but the size of each of these groups will be increased.

The plan has been reviewed by our South Zone Wildlife Biologist. In general, we support the proposal to increase the size of the management unit to more closely reflect the natural range of the lion population. Specifically, we appreciate the proposal to lower the female harvest to 22% of the total and change it to only adult females rather than all ages.

If you have any questions, please contact me at (720) 822-0569 or patricia.hesch@usda.gov. Once the plan is finalized, please provide a copy to the Sulphur District Ranger at the above address, and to Aurelia DeNasha, South Zone Wildlife Biologist, at aurelia.e.denasha@usda.gov.

Sincerely,

Invalid signature

X Patricia Hesch

Signed by: PATRICIA HESCH

PATRICIA HESCH
Acting District Ranger

cc: Aurelia DeNasha, aurelia.e.denasha@usda.gov

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Northwest District Office
2300 River Frontage Road
Silt, CO 81652

In Reply Refer To:
1220, 1610 (CO-N00) **P**

April 27, 2020

Colorado Parks and Wildlife
ATTN: Lyle Sidener
Area Wildlife Manager, Area 9
346 Grand County Road 362
Hot Sulphur Springs CO, 80451

Dear Mr. Sidener,

Thank you for the opportunity to review the Draft 2020 Lion Population Management Plan. The BLM Colorado Northwest District consists of the following field offices:

Colorado River Valley Field Office (Silt, CO)
White River Field Office (Meeker, CO)
Little Snake Field Office (Craig, CO)
Kremmling Field Office (Kremmling, CO)

These four field offices have completed a comprehensive review of the Draft Lion Population Management Plan and have concluded the plan is consistent with approved Resource Management Plans for each field office.

I would like to take this opportunity to highlight the outstanding partnership the BLM Colorado Northwest District has established with Colorado Parks & Wildlife. Thank you for your engagement with our offices and staff on managing resources so effectively.

My point of contact for the Draft Lion Population Management Plan is Patty Luby, Associate District Manager (Acting). She may be reached at 970-826-5088 or pluby@blm.gov.

Sincerely,

Stephanie Connolly

Stephanie Connolly
District Manager

MESA COUNTY
COLORADO
BOARD OF COUNTY COMMISSIONERS
District 1 - John Justman 970-244-1605
District 2 - Scott McInnis 970-244-1604
District 3 - Rose Pugliese 970-244-1606

P.O. Box 20,000 544 Rood Avenue Grand Junction, Colorado 81502-5010 mcbocc@mesacounty.us

April 6, 2020

Mr. Dan Prenzlow, Director
Colorado Parks and Wildlife
1313 Sherman Street, 6th Floor
Denver, CO 80203

RE: Colorado West Slope Mountain Lion (Puma concolor) Management Plan, Northwest and Southwest Regions

Comments submitted via online comment tool:
https://docs.google.com/forms/d/e/1FAIpQLSepRSePhtZRmusBrcp7Hfm_5dk_dpggUpzR6SuHdsCjr0jjZw/viewform

Dear Director Prenzlow:

The Mesa County Board of Commissioners ("Mesa County") appreciates the opportunity to offer comments on the proposed Colorado West Slope Mountain Lion (Puma concolor) Management Plan for the Northwest and Southwest Regions.

Mesa County is supportive of CPW's efforts to manage predators in a way that creates checks and balances for all species across the landscape.

1. Reduction in human-lion conflict should be a top priority of lion management in western Colorado. In addition to management through annual harvest permits, educating homeowners on strategies to deter lions from revisiting residences would be helpful in reducing the potential for human-lion conflict.

2. Ensuring big game populations of deer, elk and moose are stable and healthy are a priority given the economic and socioeconomic contributions of hunting and wildlife viewing to not only Mesa County, but also that of the entire western slope.

3. As identified in the draft plan, the L-7 Grand Mesa/North Fork Data Analysis Unit ("DAU") was managed previously for suppression due to "high rates of game damage (livestock depredation)."[1] Continuing to manage the lion population on the Grand Mesa to reduce the impacts of depredation on livestock is important in Mesa County considering the prevalence of agriculture and ranching operations.

[1] CPW (Colorado Parks and Wildlife). Spring 2020. Colorado West Slope Mountain Lion (Puma concolor) Management Plan, Northwest and Southwest Regions (p.10).

As lion populations function on a larger landscape, we understand the need to manage the species on a larger scale, however, we also believe that it is important for all resource management plans to allow for adaptive management by local resource managers, especially as quickly as localized conditions change and new science becomes available.

Thank you for your consideration of these comments.

Sincerely,

Scott McInnis, Chair Board of County Commissioners	Rose Pugliese Commissioner	John Justman Commissioner

cc: The Honorable Cory Gardner
The Honorable Michael Bennet
The Honorable Scott Tipton
The Honorable Ed Perlmutter
The Honorable Diana DeGette
The Honorable Joe Neguse
The Honorable Ken Buck
The Honorable Doug Lamborn
The Honorable Jason Crow

County Commissioners:
Keenan G. Ertel
Larry Don Suckla
Jim Candelaria
County Administrator:
Shak Powers

Board of County Commissioners

109 West Main, Room 302
Cortez, CO 81321
(970) 565-8317
(970) 565-3420 Fax

April 30, 2020

Matt Thorpe
Area Wildlife Manager
Area 15 Durango
151 E. 16th St. Durango, CO 81321

Dear Mr. Thorpe;

Thank you for the opportunity to comment on the Colorado Draft Mountain Lion Management Plan. Montezuma County recognizes Mountain Lions are a valuable wildlife resource to the State. County residents have lived along-side Mountain Lions since the County was first populated, and the population seems to be doing very well here. Our community is steeped in the folklore surrounding these big cats, and many residents still participate in lion hunts. We appreciate the difficulty in finding a balance between maintaining a stable, viable mountain lion population, and keeping human/ livestock conflicts at a minimum.

Montezuma County can generally live with the "stable population" strategy across the broader Western Slope. Within Montezuma County, however, we may need to be able to apply more flexibility. We certainly have lingering concerns with our mule deer herd, and we believe that there is a direct correlation between mule deer numbers and predator numbers. Until the mule deer numbers recover we feel that CPW needs to maintain maximum management flexibility to respond to localized population concerns, both with deer and lions.

The harvest limit strategy seems worth pursuing, and we agree with the larger "landscape-scale" of the hunting units, which we agree, may increase the success rate with more geographic access. We feel harvest limits should be set near the top of the range and backed off versus set too low, to begin with. As the plan describes mountain lion recovery, the population seems to rebound very quickly when the pressure is taken off. This should lessen population stability concerns in the urban/wildland intermix area, which we feel is a "source" area. We feel like starting with higher harvest numbers, and taking a ramp down approach, is better than a ramp-up approach for Montezuma County.

County residents have been living alongside lions for a long time, but we still clearly have conflicts that occur regularly and we need to retain enough flexibility to rapidly respond to evolving wildlife concerns. We are in favor of creating regulation that allows for electronic calls to increase harvest potential in areas that are difficult to hunt with hounds. The use of electronic calls may also create a new hunting opportunity to hunt on small parcels within the urban /wildland intermix.

We also support extending hunting seasons into April, as needed, and within certain units, including 70, 71, 72, 73, and 711. These units are very difficult to hunt and the extra time in the field is essential to meeting harvest targets.

While we hope the electronic calls will be successful, we feel we also need to plan for their failure. Assuming electronic calling just never becomes popular enough, or he the success rate is still too low, we feel that a suppression strategy should still be on the table, in the event I need to be implemented. While we are hopeful for the success of a more surgical approach to harvest, it remains to be seen if numbers go up at all. If more localized strategies are not working we need to be able to go back to the broader view and revert to a suppression strategy across broad regions of the western slope.

On Behalf of the Montezuma County Board of County Commissioners,

James Dietrich
Montezuma County Natural Resources

La Plata County Colorado
Board of County Commissioners
Clyde Church, Chair • Gwen Lachelt, Vice Chair • Julie Westendorff, Commissioner
1101 East 2nd Ave
Durango, CO 81301
(970) 382-6219

April 28, 2020

Colorado Parks and Wildlife
Attn: Matt Thorpe
151 E 16th Street
Durango, Colorado 81301

RE: CPW Mountain Lion Management Plan

Dear Mr. Thorpe:

La Plata County appreciates the opportunity to provide a letter of support and comment to Colorado Parks and Wildlife (CPW) for the West Slope Mountain Lion preliminary management plan on lands within La Plata County. La Plata County supports this plan proposing to manage mountain lions on a regional scale and providing accurate data and flexibility for maintaining population stability. This plan identifies the issues mountain lions face from development and decline in prey populations. Education and outreach remain an important factor for long term management for stable populations.

This plan outlines the management steps needed to continue CPW's objectives and provides mitigation to protect this natural resource. Tourism provides economic benefits to our local economy from hunters, trail users and outdoor enthusiasts. Outdoor recreationist demands for more trails results in more big game conflicts. La Plata County continues to support seasonal closures for big game that helps protect winter range activities for all wildlife.

La Plata County supports CPW working with the Living with Wildlife Advisory Board to help educate the public about impacts from recreationist near critical habitats. La Plata County will continue to help educate through the Land Use Code by way of developers and how to help manage living in an area that supports big game wildlife. CPW's capacity to regionally manage a flexible plan for mountain lions within La Plata County benefits our local community and creates economic value to our area.

La Plata County staff technical comments:

- It is recommended that a predator/prey portion be added to this analysis. A detailed analysis and added considerations for lion harvest and population management as well as need for revision should be completed and detail the potential impacts that may be

observed on other game and non-game species as lion numbers increase. This analysis should include the impacts that are anticipated to other game and non-game prey species (for example increased predation on turkey populations causing reduced turkey tag allocation).

La Plata County appreciates this opportunity to participate and comment on this plan. We recognize the importance of what CPW is trying to accomplish with mountain lions and how to best manage them. Thank you for your coordination in helping to ensure reduced conflict for mountain lions and while working to meet everyone's best interest.

Sincerely,

LA PLATA COUNTY
BOARD OF COUNTY COMMISSIONERS

Clyde Church
Chair

Gwen Lachelt
Vice Chair

Julie Westendorff
Commissioner

BOARD OF COUNTY COMMISSIONERS
OF RIO BLANCO COUNTY, COLORADO
555 MAIN STREET | P.O. BOX 599 | MEEKER, COLORADO 81641
(970) 878-9430

April 30, 2020

Sent via email to: bill.devergie@state.co.us
Mr. Bill de Vergie
Area Wildlife Manager
PO Box 1181
Meeker, CO 81641

RE: Support of the Colorado Parks and Wildlife West Slope Mountain Lion Management Plan

Dear Mr. de Vergie:

This letter is to confirm Rio Blanco County's support for the proposed Colorado Parks and Wildlife West Slope Mountain Lion Plan.

Colorado Parks and Wildlife presented the proposed plan during an open meeting on February 11, 2020. After reviewing and discussing the proposed plan, Rio Blanco County has determined the plan is consistent with the 2016 Rio Blanco County Land and Natural Resource Plan and Policies. The proposed plan provides for immediate lion management while providing for flexible long-term management of the species.

If you have any questions, or need anything further, please contact us at bocc@rbc.us. Thank you for allowing us the opportunity to comment on this important plan.

The Board of County Commissioners of
Rio Blanco County, Colorado

Jeff Rector, Chairman	Si Woodruff	Gary Moyer

JEFF RECTOR	*SI WOODRUFF*	*GARY MOYER*
Chairman	*Commissioner*	*Commissioner*
	bocc@rbc.us	

BOARD OF COUNTY COMMISSIONERS
ARCHULETA COUNTY, COLORADO

P.O. Box 1507 / 398 Lewis Street / Pagosa Springs, Colorado 81147
Tel (970) 264-8300

April 30, 2020

Mr. Matt Thorpe
Area Wildlife Manager
Colorado Parks and Wildlife
151 E. 16th Street
Durango, CO 81301

Dear Mr. Thorpe,

We, the Board of County Commissioners of Archuleta County (the "Board") support the Colorado West Slope Mountain Lion Management Plan (the "Plan") recently drafted by Colorado Parks and Wildlife ("CPW") as well as supporting recreational hunting as a management tool. We do not support limiting lion hunting or infringing on what has already been established.

The Plan provides a strategy to maintain a relatively stable mountain lion population in western Colorado and provides local managers flexibility in distribution of harvest limits, while still ensuring the maintenance of population stability throughout Colorado.

The Board applauds the work done by Colorado Parks and Wildlife and we encourage CPW to continue investigating and updating their research on the lion habitat in southwestern Colorado.

Very truly yours,

Ronnie Maez
Chairman

EAGLE COUNTY

Board of County Commissioners
970-328-8605
970-328-8629(f)
eagleadmin@eaglecounty.us
www.eaglecounty.us

April 29, 2020

Colorado Parks and Wildlife Commission
1313 Sherman St.,
Denver, CO 80203

Wildlife Commissioners,

The Eagle County Board of Commissioners supports the proposed West Slope Mountain Lion Plan. The new proposal provides several new management strategies that will allow for a holistic management of lions across the west slope of Colorado. Primary among these is the realignment of management unit boundaries to more accurately reflect the actual home ranges of mountain lions. Along with the realignment of units, the decision to manage lions on a harvest limit basis instead of a GMU quota basis allows more flexibility and allows harvest to occur where necessary. The general concept of maintaining the mountain lion population at a stable level throughout most of the west slope is an appropriate management objective. Utilizing both the total mortality indices and the adult female harvest as parameters to determine that populations are within that stable range is prudent.

The Special Management Area described within this plan partially resides within Eagle County. The Board recognizes that interactions between people and lions have increased in the last ten years. The Board is concerned for the safety of both the lions and the residents and understands that implementation of lion management will help address the situation. As with all wildlife management, the board hopes there is flexibility built into this plan to allow adaptive management for changing conditions within management areas.

Thank you for the opportunity to comment.

Sincerely,

Kathy Chandler-Henry	Matt Scherr	Jeanne McQueeney
Chair	Commissioner	Commissioner

April 24th, 2020

Colorado Parks and Wildlife
1313 Sherman St.
Denver, CO 80203

Wildlife Commissioners,

The Town of Minturn would like to voice their support of the proposed West Slope Mountain Lion Plan. Minturn and the surrounding areas have seen an increase in human-mountain lion conflict over the last several years and we believe that this updated plan provides the flexibility to more appropriately manage the mountain lion population and any subsequent human-lion conflicts.

The new proposal provides several new management strategies that will allow for a holistic management of lions across the west slope of Colorado. Primary among these is the realignment of management unit boundaries to more accurately reflect the actual home ranges of mountain lions. Along with the realignment of units the decision to manage lions on a harvest limit basis instead of a game management unit quota basis allows more flexibility and allows harvest to occur where necessary.

The general concept of maintaining the mountain lion population at a stable population level throughout most of the west slope is an appropriate management objective. Utilizing both the total mortality indexes and the adult female harvest as parameters to determine that populations are within that stable range is prudent.

Furthermore, The Town of Minturn lies within the Special Management Area described in this plan. We, as a town, recognize that interactions between people and lions have seen a dramatic increase in the last ten years. The safety of the residents of our town remains a priority, and we understand that an update to current lion management is needed.

As presented, the West Slope lion management plan is a significant step in the right direction and will help provide the flexibility in managing towards a more stable and biologically sound lion population in our area.

Sincerely,

John Widerman
Mayor
Minturn Town Council

As proposals which threaten the continued harvest and science-based management of certain game species in Colorado have been put forth to the Colorado Parks & Wildlife, Colorado Backcountry & Anglers would like to re-emphasize our longstanding support of the full set of management principles put forth through the North American Model of Wildlife Conservation https://wildlife.org/wp-content/uploads/2014/05/North-American-model-of-Wildlife-Conservation.pdf. This time-tested fish and wildlife management approach has led to healthy populations of fish and wildlife and provide unparalleled opportunities to hunt, fish and otherwise enjoy Colorado's fish and wildlife. For this model to continue to be successful, it is imperative that hunters, anglers and wildlife managers continue to have all the necessary tools available to effectively manage wildlife populations through science. While we recognize and appreciate the importance of public input on fish and wildlife management decisions, proposals to prohibit hunting or trapping of certain species, without reasonable scientific evidence threaten to undermine the bedrock of our widely successful model of fish and wildlife management in North America.

Colorado Backcountry Hunters and Anglers support Colorado Parks and Wildlife's current upgrades to their big game management plans, as those plans reflect the scientific and philosophical underpinnings of the North American Model laid out above.

RMEF

CHAPTER

To Whom It May Concern:

On behalf of the Eagle Valley Chapter of the Rocky Mountain Elk Foundation I Ray Long Chairman would like to voice my support for Colorado Parks and Wildlife Mountain Lion Management plan. We feel that it is sound conservation for all wildlife to be actively managed according to human and other wildlife's needs, ever since Amendment 14 Colorado's predator populations have exploded to unhealthy numbers both for prey species and predator species. Competition for territory has driven predator's of all species into close proximity of human populations while prey herds dwindle drastically even with prey species hunting license allocations being reduced or eliminated in some cases.

We feel that this plan is a step in the right direction that will give State Wildlife managers sufficient data in the continued research of managing wildlife, Mule Deer and Elk herds in Southern Colorado are currently under carrying capacity and in some areas the populations are down 50% - 60%, we feel that CPW has to do something to help stabilize the prey species populations before these herds reach the critical limit and disappear from these historic ranges. A reduction in predator pressure due to increased hunting opportunities for predators is the most economic and efficient method to study the affects large predators play on prey populations and Hunters gladly help fund this plan with more license sales.

Thank you for taking our perspective into consideration, showing our support for Colorado Parks and Wildlife in their continued mission to preserve, protect and defend Colorado's wildlife for future generations. We fully believe the increased harvest of predators is a step in the right direction and we hope you do as well!

Sincerely Yours in Conservation

Ray Long

RED SKY RANCH

April 10, 2020

RE: West Slope Mountain Lion Plan

Our Association, Red Sky Ranch Association, is writing this letter in support of the new West Slope Lion Plan; in particular the support of the Special Management Area and the choice to manage lions in this area for a declining population. We are located within the designated Special Management Area of the plan, just south of Wolcott. We have also experienced the increase in human mountain lion interactions within our community to the point of impacting and dictating people's lives and activities. The residents of the community are aware that they have moved into lion habitat and of the potential ramifications that entails. However; the number of interactions, the timing of the interactions (all times of the day), and most disturbing the behavior of the lions upon being encountered is increasing and becoming a potential safety factor. Some lions are not fleeing when encountered and are being seen out in the open on walking trails within the development at all times of the day. Because of the number of human/ lion incidents and the unusual behavior the lions exhibit around people, we requested that CPW increase the quota of licenses in GMU 44 prior to this new plan being proposed. The West Slope Plan addresses our concerns and request.

Sincerely,

Mike Trueblood

Red Sky Ranch Association Manager

P.O. Box 100

Edwards, CO 81632

mjtrueblood@vailresorts.com

P.O. Box 100 Edwards, CO 81632 TEL 970-754-6905 FAX 970-754-6906

Singletree Property Owners Association
Post Office Box 1200
Edwards, CO 81632
970.926.2611
manager@singletreetoday.com

April 29, 2020

Colorado Parks and Wildlife Commission
1313 Sherman Street
Denver, CO 80203
Email: dnr_cpwcommission@state.co.us

Dear Wildlife Commissioners,

The Singletree Property Owners Association expresses our support of the proposed West Slope Mountain Lion Management Plan. Singletree is in north Edwards, Eagle County, Colorado. Our community strives to be good stewards of the environment and appreciates wildlife and the value of living in this area. We respect and care for our natural resources but must also balance the health and safety of our residents. The current mountain lion management plan needs to be updated. It can no longer keep pace with the growing number of human – mountain lion conflicts in our community, and the updated plan is necessary to meet the needs of both mountain lions and our residents. During the 2019-2020 winter alone, our residents experienced a significant increase in mountain lion activity, which included attacks on dogs and stalking of humans. Mountain lions were active throughout the day and night, and in several cases, appeared to have no innate fear of humans. The conflicts have been increasing in the Edwards area for the last decade. While working with Colorado Parks and Wildlife to educate homeowners and mitigate potential risks to the community, the changing situation requires an increasing need for additional management tools to lessen wildlife conflicts and manage towards a healthy mountain lion population. In this regard, we support the proposed plan as it provides flexibility, distributes lion harvest limits across the landscape in a more efficient manner, and balances the wildlife needs with the safety of our residents. The realignment of unit boundaries more accurately reflects mountain lion home ranges and allows hunter harvest to more easily occur where it is needed.

Ultimately, the overarching concern for our community is the health and safety of the residents, and we feel that this plan addresses those concerns, but also gives managers the flexibility to adapt to changing conditions, all while aiming for a stable mountain lion population.

Kind Regards,

Courtney Holm
President
Singletree Property Owners Association

EAGLE RANCH WILDLIFE COMMITTEE
c/o Eagle Ranch Association
PO Box 1630
Eagle CO 81631

March 25, 2020

Colorado Parks and Wildlife Commission
6060 Broadway
Denver, CO 80216

Re: West Slope Mountain Lion Plan

To Whom It Concerns:

The Eagle Ranch Wildlife Committee hereby expresses its unanimous support for the draft West Slope Mountain Lion Management Plan ("Plan").

The Eagle Ranch Wildlife Committee was established in 1999 in connection with the approval of the Eagle Ranch PUD. The Committee is responsible for administering funds raised from a transfer tax for the purpose of preventing, minimizing and mitigating impacts on wildlife from development. All of Eagle Ranch lies south of the original Town of Eagle within the area designated in the plan as a Special Management Area. This area has seen a significant increase in the number of human/lion interactions over the past ten years both within the community and in the adjacent highly used recreational trail system.

Wildlife interactions with humans are rarely beneficial to wildlife. Increased interactions between residents of Eagle Ranch (and their pets) and mountain lions will be detrimental to the mountain lions because they are likely to lead to immediate demands to remove the lions. The Committee believes that implementing a long-term plan to minimize these interactions is far better than waiting for the types of wildlife/human contact that lead to short-term demands.

Therefore, the Committee supports the goal of gradually decreasing the number of lions within the Special Management Area. This is consistent with our commitment to maintaining healthy, viable wildlife populations for future generations.

The members of the Committee understand that the home range of mountain lions is significantly different from the range of other regulated animals, such as ungulates. Therefore, the Committee supports the new geographic hunting units depicted in the Plan, which should allow for better management through designated harvest limits. While the actual proposed harvest limits for the new units may decrease in number from the former Game Management Unit quota system, the dispersal of hunters into larger hunting areas should allow managers to more effectively maintain lion populations at current levels.

The Committee appreciates the opportunity to comment on the Plan and thanks the Colorado Parks and Wildlife Commission for considering these comments.

Sincerely,

Scott Turnipseed
Chair
Eagle Ranch Wildlife Committee

May 11, 2020

Colorado Parks & Wildlife Commission
1313 Sherman St.
Denver, CO 80203

Re: West Slope Mountain Lion Management Plan Comments from SCI and SCIF

Dear Commissioners,

Safari Club International and Safari Club International Foundation ("SCI" and "SCIF") appreciate the opportunity to comment on Colorado Parks & Wildlife's ("CPW") proposed West Slope Mountain Lion Management Plan.

Safari Club International, a nonprofit IRC § 501(c)(4) corporation, has approximately 45,000 members worldwide, many of whom enjoy outdoor recreation including hunting in Colorado. SCI also has chapters around the world, including four local chapters in Colorado. SCI's missions include the conservation of wildlife, protection of the hunter, and education of the public concerning hunting and its use as a conservation tool.

Safari Club International Foundation is a nonprofit IRC § 501(c)(3) corporation whose missions include the conservation of wildlife, education of the public concerning hunting and its use as a conservation tool and humanitarian services. SCIF's conservation mission is to support conservation of the various species and populations of game animals and other wildlife and habitats on which they depend. SCIF's staff includes wildlife biologists who are knowledgeable about many different wildlife-related issues, including management of predator species.

SCI and SCIF strongly support Colorado's wildlife management authority. SCI and SCIF commend the CPW staff and terrestrial biologists for their work to make the plan's update a transparent, public process based on the best available science. The proposed changes are needed to manage mountain lions at scale, incorporate new scientific information, modernize outdated management units and improve overall harvest management.

The plan incorporates several new approaches which will improve the management of mountain lions. These approaches are based on scientific studies that have improved our understanding of lion ecology and population monitoring. SCI and SCIF strongly support these updates. A landscape-level approach, broadly outlined by the Northwest and Southwest Regions replacing existing Data Analysis Units, is more appropriate to spatially manage mountain lion populations while maintaining flexibility in harvest regimes and addressing conflict with humans and livestock. The two regions will further be managed

Safari Club International & Safari Club International Foundation
501 2nd Street NE, Washington, DC 20002 • www.safariclub.org, www.safariclubfoundation.org

for harvest objectives under source-sink dynamics using harvest limit groups, or pools of existing game management units, every three years to allow for an adaptive response to the monitoring results.

Due to difficulties in accurately estimating lion abundance, hunter harvest is a valuable input to models that assess population trends and can be utilized as a monitoring tool. SCI and SCIF support the use of hunter harvest data in lion population modeling, a common practice among state wildlife authorities. To ensure sustainability, annual harvest within the limit groups will be set based on certain mortality thresholds (22% female harvest or 17% total human-caused mortality) and adjusted accordingly based on these metrics. The adult female harvest is conservatively set to protect the reproductive demographic, and both metrics are aligned with research findings from mortality studies across the western United States. Any over-harvest will trigger CPW outreach to hunters, training for houndsmen/women and subsequent reductions in harvest. SCI and SCIF applaud CPW for this approach, which properly balances conservation, human-lion conflict management and hunting opportunity.

Rural Coloradans, hunters and other recreational users know that human-lion conflict is increasing and a concern to public safety. CPW's updated plan adequately addresses conflict in special units such as the Glenwood area and appropriately uses hunting as a management option among other mitigation tools. Whereas selective hunting with hounds allows for highly targeted management, SCI and SCIF support the flexibility to allow a concurrent harvest license during other big game seasons to meet management objectives. We also support maintaining the ability to use a variety of methods of take, such as the use of electronic calls in certain units, to meet harvest objectives.

Furthermore, the proposed plan is compatible with the CPW's West Slope Mule Deer Strategy's goal of stabilizing, sustaining and increasing mule deer populations in western Colorado while maximizing hunting and recreational opportunity. Part of the strategy, which went through its own public engagement process, includes lion reduction where predation is a limiting factor on mule deer survival.

The CPW has incorporated an extensive review of the scientific literature—138 peer-reviewed studies available in Appendix D—including new information on lion biology, spatial modeling, monitoring metrics, density estimation and population trends from the last 15 years. The agency is also initiating a mark-resight density monitoring program to make their population indices more robust. They have gone through the appropriate public process and will continue to receive support from SCI members in Colorado. SCI and SCIF's review concurs that this plan and the subsequent monitoring program are well-supported both by science and the needs of maintaining a stable mountain lion population.

CPW's mandate and goal is to manage for a stable lion population while putting public safety first and providing the maximum amount of hunting and other recreational opportunity. SCI and SCIF fully support the proposed updates and urge the Commission to adopt the management plan.

Sincerely,

Mr. Steve Skold

President
Safari Club International

Mr. Warren Sackman

President
Safari Club International Foundation

Safari Club International & Safari Club International Foundation
501 2nd Street NE, Washington, DC 20002 • www.safariclub.org, www.safariclubfoundation.org

April 29, 2020

Brian Dreher
Terrestrial Section Manager
Colorado Parks and Wildlife
6060 Broadway
Denver, CO 80216
brian.dreher@state.co.us

Mark Vieira
Carnivore and Furbearer Program Manager
Colorado Parks and Wildlife
317 W. Prospect
Fort Collins, CO 80526
mark.vieira@state.co.us

RE: Draft Colorado West Slope Mountain Lion (*Puma concolor*) Management Plan

Dear Mr. Dreher and Mr. Vieira:

On behalf of the undersigned organizations and our supporters in Colorado, we thank you for the opportunity to submit the following comments regarding the Colorado Parks and Wildlife ("CPW") Draft Colorado West Slope Mountain Lion (*Puma concolor*) Management Plan ("Plan").

The Plan provides CPW an opportunity to not only include the best available science regarding mountain lions, but also establish a comprehensive guidance document to inform management needs, strategies, and goals for all Coloradans as well as our state's much loved wildlife and entire ecosystems. As such, we support and appreciate CPW's efforts to produce an updated Plan for mountain lions living in the West Slope region of Colorado as the agency's previous plans are outdated and are not representative of current management needs or strategies based on current research.

Our organizations are generally opposed to the hunting of mountain lions in Colorado and beyond. These iconic native carnivores are killed by hunters primarily for the purpose of obtaining a trophy and not for subsistence. Mountain lions must be managed for all Coloradans and that CPW has an obligation to manage wildlife with the values of all residents in mind. We support CPW's efforts to improve management of mountain lions through this Plan, such as establishing density and population estimates for mountain lions, as well as implementing mortality thresholds, including a 17% total human-caused mortality limit and a 22% adult female mortality limit. We do, however, recommend a set of changes to the Plan for incorporation prior to its finalization.

1. CPW should use a reduced density estimate of two independent mountain lions per 100km^2 to establish population estimates and mortality limits, at least until CPW has more precise density estimates for mountain lions in a diversity of habitat types across the state. CPW's current mountain lion resource selection function likely overestimates mountain lion densities, resulting in population estimates that exceed the number of mountain lions present on the landscape and allowing for mortality limits that are not sustainable.

2. The Glenwood Special Management Area should be managed with the same mortality limits as the rest of the West Slope. While we respect and understand the pressure placed on CPW to respond to mountain lion conflicts, research shows that high levels of hunting will only result in increased conflicts. We recommend an alternative approach, including increased public education and the implementation of non-lethal strategies and tools, to address human/mountain lion conflicts rather than a lethal approach that is not only ineffective but may result in decreased public safety and increased conflict.
3. CPW should not allow for the use of electronic calls to hunt mountain lions. Electronic calls are unsporting and not in line with the Colorado Parks and Wildlife Commission's Fair Chase Policy.[1]
4. CPW should not extend hunting of mountain lions, including during deer and elk hunting season. Allowing earlier hunting that overlaps with peak birthing months will likely result in greater mortality of pregnant mountain lions and young kittens.
5. CPW should acknowledge the enormous benefits mountain lions provide to other wildlife and entire ecosystems. The draft Plan is solely focused on managing mountain lions for hunting purposes. Instead, the Plan should include the abundance of research detailing the role mountain lions play as keystone species in their environment, such as by providing food sources for other wildlife, removing sick ungulates from their herds, and enhancing healthy and biodiverse ecosystems.

The following comments further bolster these recommendations:

I. CPW should use a reduced density estimate of two independent mountain lions per 100km^2 to establish population estimates and mortality limits.

We recommend that CPW rely on a density estimate of two independent mountain lions per 100km^2 (2/100km^2) rather than the current estimates of 2.8/100km^2 in the northwestern region and 2.6/100km^2 in the southwestern region of the West Slope. This is necessary to employ a conservative management approach, relying on the best available science across the western U.S. Currently, the Plan relies on mountain lion density estimates that exceed the best available research. As a result, the agency's mountain lion population estimate is likely higher than the actual population size and, therefore, the harvest objectives are likely not sustainable.

As detailed in Appendix C of the Plan, CPW separates the state into four strata which define habitat suitability for mountain lions and assigns density estimates for each strata. In areas where likely no or very few mountain lions ever reside (Strata 1), CPW assigns a density of 1 lion/100km^2. We recommend Strata 1 be assigned a density estimate of zero, as mountain lions rarely, if ever, select this habitat. Assigning a value to the lowest-quality habitat leads to an overestimated density output. Indeed, we recommend assigning a value of 0/100km^2 to Strata 1 land in order to obtain more precise estimates of abundance.

In areas with only slightly more suitable habitat (Strata 2), CPW assigned a density of 2.5 lions/100km^2. Yet, when comparing mountain lion density research, such as those detailed in Table 1 of Appendix A, it is evident that a density of 2 lions/100km^2 is the average density for mountain lions within suitable habitats. An estimate of 2.5 lions/100km^2 not only exceeds these findings, it assigns this higher density to a less preferred habitat type. Likewise, CPW assigns both Stratas 3 and 4 a staggeringly high density of 4.2 lions/100km^2. CPW's own research on the Uncompahgre Plateau, an area thought to consist of high quality habitat for mountain lions, shows an estimated density of 1.9 to 2.8/100km^2 for a hunted population according to the Plan.[2] It appears that only one current and reliable study[3], conducted in Boulder, Colorado, documented a higher mountain lion density of 4.1/100km^2. This one study is insufficient to justify such high presumed mountain lion densities on the West Slope. Density estimates

in Stratas 2, 3 and 4 must be shifted downward, at least until CPW is able to conduct and publish reliable research indicating that higher density estimates are justified across the West Slope.

Until CPW can conduct further density research, it is necessary to limit both the northwestern and southwestern region-wide average independent lion densities to no more than 2/100km^2 to help prevent hunting at unsustainable levels. Furthermore, we call upon CPW to obtain meaningful review of the agency's mountain lion habitat and density model by a body of its peers, including in-state wildlife agencies, agencies outside of Colorado and university experts who have experience with mountain lion density and population abundance research.

II. The Glenwood Special Management Area should be managed with the same mortality limits as the rest of the West Slope and should employ a stronger non-lethal management campaign to prevent conflicts.

Sightings of mountain lions do not necessarily equate to conflicts or increased threats to public safety. CPW has consistently acknowledged the rarity of human conflicts with mountain lions and continues to reinforce the notion that simply seeing a mountain lion is not a cause for concern. Therefore, increased sightings of mountain lions in an area does not provide sufficient justification for increased hunting. As such, we are opposed to the management approach proposed for the Glenwood Special Management Area ("SMA"), where CPW will employ increased hunting of mountain lions as a method to address human/mountain lion conflicts and exclude this area from the Plan's regional monitoring thresholds. This approach is not only ineffective but harmful for addressing conflicts in that this strategy has been shown to exacerbate conflict.

We call on CPW to increase coexistence and conflict prevention strategies in areas where sighting have led to concern among members of the public. Public outreach that includes a stronger public education campaign and providing members of the public with non-lethal strategies and tools that will deter mountain lions can build greater understanding for the role the public plays in preventing conflicts. While we recognize that CPW is already employing some non-lethal efforts in this region and the plan includes efforts to increase public education, these efforts should be increased further and would receive the support from Colorado's public majority.

Research shows that mountain lion conflicts with humans, pets and livestock are higher in areas where hunting occurs.[4] Hunting and predator control of mountain lions results in increased conflicts because mountain lions' social structure is destabilized.[5] A recent review of predator-removal studies found that the practice is "typically an ineffective and costly approach to conflicts between humans and predators" and, as a long-term strategy, will result in failure.[6] Instead, the authors concluded, non-lethal alternatives to predator removal, coupled with livestock-carnivore coexistence strategies (husbandry techniques) may resolve conflicts.[7]

The Plan acknowledges the extensive research out of Washington state which indicated that increased mountain lion hunting resulted in increased complaints. As mountain lion complaints increased, wildlife officials lengthened seasons and increased bag limits to respond to what they believed was a rapidly growing mountain lion population. However, the public's perception of an increasing population and greater numbers of livestock depredations was actually the result of declining numbers of females and increasing numbers of young males in the population.[8] Heavy hunting of mountain lions skewed the sex-age structure of the population to a domination of young males by facilitating compensatory immigration, even though it resulted in no net change in the population size.[9]

Study authors found that sport hunting of mountain lions to reduce complaints and livestock depredations had the opposite effect. Killing mountain lions disrupted their social structure and increased both complaints and livestock depredations.[10] Peebles et al. (2013) write:

> . . . each additional cougar on the landscape increased the odds of a complaint of livestock depredation by about 5%. However, contrary to expectations, each additional cougar killed on the landscape increased the odds by about 50%, or an order of magnitude higher. By far, hunting of cougars had the greatest effects, but not as expected. Very heavy hunting (100% removal of resident adults in 1 year) increased the odds of complaints and depredations in year 2 by 150% to 340%.[11]

Hunting disrupts mountain lions' sex-age structure and tilts a population to one that is comprised of younger males, who are more likely to engage in livestock depredations and infanticide than mountain lions in stable, older populations.[12]

In March 2019, the Humane Society of the United States published a report on livestock losses from mountain lions using the U.S. Department of Agriculture's data.[13] For Colorado's sheep and cattle ranchers, the most recently available data from 2014 and 2015 data show that the majority of losses came from maladies (illnesses, birthing problems, weather and theft) with far fewer losses coming from all native carnivores and domestic dogs together (Fig 1).

Fig. 1, Colorado's unwanted cattle and sheep losses by cause[14]

	Total unwanted losses	Losses from maladies (illness, birthing problems, etc.)	Losses from all predators	Losses from cougars
Cattle	115,00	109,920 (95.58%)	5,080 (4.42%)	208 (0.18%)
Sheep	29,000	16,346 (56.37%)	12,654 (43.63%)	792 (2.73%)

In 2015, only 0.18 percent of unwanted cattle losses in Colorado were from mountain lions, compared with more than 95 percent from maladies, according to the USDA.[15] In 2014, only 2.7 percent of unwanted sheep losses in Colorado were from mountain lions.[16] Even with these low predation numbers, the USDA reports are likely exaggerated because of their faulty methodology; we compared U.S. Fish and Wildlife Service and states' data to the USDA and found the latter to be excessive in their attribution of livestock deaths to native carnivores and domestic dogs.[17]

The Plan acknowledges the extensive research conducted in Washington state and British Columbia which shows this correlation between hunting and mountain lions conflicts. Yet, the Plan seeks to dismiss the body of research based on a single study by Hiller et al. (2015) that is focused on livestock depredation, not human/mountain lion conflict. Moreover, Hiller et al. (2015) actually reinforces the notion that hunting in Colorado will likely not prevent conflicts, finding that "cougar mortalities did not increase as the density of cougars harvested increased when the estimated cougar densities were 2/100km^2 or 3/100 km^2, densities that align with those in Colorado. In fact, only at extremely high densities of 5/100km^2, and when juvenile males made up 40 percent of the population (suggesting a possible population sink) did Hiller et al. (2015) claim that hunting could reduce conflicts.

Indeed, Hiller et al. (2015) does demonstrate that higher densities of subadult males result in increased conflicts, supporting the studies previously mentioned. Increased hunting of mountain lions may then only provide a temporary fix but will likely lead to destabilized populations and increased conflicts. Such heavy harvest, leading to what would be no less than localized extirpation of the species, is not

sustainable over the long-term. In sum, as research indicates, sport hunting of lions to reduce complaints skews the population age-sex structure to young males, which exacerbates conflict.

Hiller et al. (2015) also do not account for external influences, such as increased awareness of and compliance with reporting requirements from livestock operators who have killed a mountain lion. While today's record keeping of mountain lion mortality from livestock depredation incidents is likely more reliable as livestock operators are increasingly aware of and participating in reporting requirements, this was likely not the case some twenty or thirty years ago, yet Hiller et al. (2015) relies on this historic data. In fact, mountain lion mortalities in Oregon as a result of livestock depredation have remained constant over the last twenty years, despite a supposed increase in the mountain lion population and rampant growth in human population.

Furthermore, Hiller et al.'s (2015) findings speak to the negative effects livestock production have on wild prey species populations more so than the correlation between hunting and mountain lion conflicts. The researchers found that mountain lion mortalities and livestock depredation remained constant when deer populations were average, regardless of mountain lion densities. In this way, mountain lions were regulated by bottom-up forces, not hunting.

Human expansion into wild spaces is an issue shared between Oregon and Colorado. Yet, as the Oregon Department of Fish and Wildlife's own data show, increases in hunting mortality have not correlated with decreases in conflicts over the last two decades. In fact, Hiller et al. (2015) conclude that the best approach for keeping conflicts low is to remove livestock from areas with low deer densities, and that hunting is likely not an effective approach because hunters would need to select for juvenile males, a challenging feat even for those who have undergone training to identify age and sex of mountain lions in the field. Instead, focused removal of individual problem animals who enter human communities, including through non-lethal options and, when necessary, lethal options, is a more effective approach.

CPW's draft plan acknowledges the likelihood that hunting will not reduce conflicts with mountain lions, stating, "Research in Colorado regarding the effects of harvest and lion population density suggest management to reduce conflict has varied results and is not solely linked to harvest," (Appendix B, p.11). This statement begs the question – if Colorado's own research already demonstrates that hunting and conflicts are not solely linked, what is the benefit of increased hunting in areas with higher levels of conflict, such as the proposed Glenwood SMA?

Moreover, because numerous studies demonstrate that increased hunting is likely not an effective, long-term approach to solving human/mountain lion conflicts, we are quite perplexed as to why CPW is not seeking to implement a comprehensive, non-lethal strategy that could result in long-term benefits to the people and wildlife within the Glenwood SMA. This could also provide an exciting opportunity to study the effects of such a strategy and the human dimensions of addressing conflicts with wildlife in ways that do not harm the local mountain lion population.

This contradiction between the best available science and the management approach proposed in the Plan demonstrate a prioritization of hunting opportunity over sound management and science-based conservation. If CPW truly wishes to reduce conflicts in these areas, the agency must dedicate further resources to working with the people within these communities to reduce attractants and respond to sightings using non-lethal methods.

III. CPW should not allow for the use of electronic calls to hunt mountain lions.

CPW seeks to allow the use of electronic calls in areas where hunting with hounds is not prudent, such as in areas near human communities or other areas with private land. Not only do electronic calls provide an unfair advantage to hunters, they also lead to more mountain lions being drawn to areas with

higher levels of human activity. This could result in more conflicts with humans, pets and livestock, undermining CPW's efforts to address conflicts with mountain lions, such as in areas near the Glenwood SMA.

Electronic calls are unsporting and not aligned with the ethics of fair chase hunting. As such, allowing electronic calls violates the Colorado Parks and Wildlife Commission's Fair Chase Policy.[18] Therefore, we are staunchly opposed to their use for mountain lion hunting in Colorado and recommend they be removed from the Plan.

IV. CPW should not extend hunting of mountain lions, including during deer and elk hunting season.

CPW seeks to create a third mountain lion hunting season to allow hunting during deer and elk hunting seasons in the Glenwood SMA. Allowing hunting during this time is exceptionally cruel as it overlaps with peak birthing season for female mountain lions. While mountain lions can give birth year-round and parturition data is varied, research has shown that the species experiences a birth pulse from mid-summer to late fall in North America.[19]

Mother mountain lions spend a significant amount of time and energy provisioning for their young and teaching them how to survive, spending an estimated 82% of their adult lives raising their kittens.[20] Kittens are reliant upon their mothers beyond 12 months of age, though they are most vulnerable during the first six months.[21] Successful reproduction is essential to sustainable mountain lion populations and necessarily includes raising young lions to a time when they can survive on their own. Killing adult female lions, who are more than 50 percent likely to have dependent young according to research,[22] undermines population sustainability by inadvertently killing the young of the year who are essential to replacing adults that have been mortally lost to hunting and natural causes.

Currently in Colorado, it is illegal to hunt mountain lion kittens and mothers traveling with kittens. Yet, mother lions often leave their kittens in the den during their first few months of life, a time referred to as the "denning period." It is only after these first few months of denning that kittens will begin to accompany their mothers to kill sites. As such, mother lions who are currently in a denning period are vulnerable to hunting as they travel alone, and their kittens will undoubtedly die as they are not yet able to survive on their own.

A Utah study showed that hunting adult females orphans their kittens, leaving them to die by dehydration, malnutrition, and/or exposure.[23] In heavily hunted populations, female mountain lions experience higher levels of intraspecific aggression resulting in predation on themselves and their kittens.[24] Thus, hunting often kills more than just the animal in the crosshairs, and can result in additional kitten mortalities that are never counted in states' hunting quotas.[25] Furthermore, over-hunting harms a population's ability to recruit new members if too many adult females are removed.[26]

O'Malley et al. (2018) found that delaying mountain lion hunting until November would avoid the denning period for 85% of dens, and delaying until December would avoid this period for 91%.[27] The study authors recommend that wildlife managers "delay the opening of mountain lion hunting seasons to 1 December, or at minimum delay hound hunting seasons until this time. In this way, managers ensure that most mountain lion dens are completed, and hunters have better opportunities to detect kittens via tracks and sign."[28]

Due to the high likelihood that an earlier season would overlap with this crucial denning period for mother mountain lions, we are strongly opposed to the creation of a third hunting season that overlaps with deer and elk hunting. Doing so will inevitably increase the killing of mother lions and the subsequent but uncounted deaths of newborn kittens. Hunting of mountain lions during the peak denning period is

not only unethical, it conflicts with the intentions of CPW's current policies of prohibiting the killing of mountain lion kittens and mountain lions traveling in groups to avoid killing kittens. We recommend this proposed season be removed from the Plan and, additionally, that CPW consider prohibiting all hunting of mountain lions before December to align with the best available science.

V. The Plan should incorporate research on the ecological benefits of mountain lions.

CPW states that the overarching goal of the Plan is to "preserve, protect, enhance and manage mountain lions for the use, benefit, and enjoyment of the state's citizens and visitors. CPW strives to ensure that mountain lions continue to exist in relatively stable numbers in western Colorado for current and future generations to enjoy through hunting, occasional observation, and for their scientific, ecological and aesthetic value," (p. 2). Yet, the Plan is solely focused on managing mountain lions for hunting purposes and does not include mention of the enormous ecological benefits mountain lions provide to other wildlife and entire ecosystems.

Mountain lions serve important ecological roles, including providing a variety of ecosystem services.[29] As such, conserving these large cats on the landscape creates a socio-ecological benefit that far offsets any societal costs.[30] Their protection and conservation has ripple effects throughout their natural communities. Researchers have found that by modulating deer populations, mountain lions prevented overgrazing near fragile riparian systems, resulting in greater biodiversity.[31] Additionally, carrion left from mountain lion kills feeds scavengers, beetles, foxes, bears and other wildlife species, further enhancing biodiversity.[32]

While the Plan discusses the role of mountain lion predation on ungulate populations, it does not mention the role of mountain lions in reducing disease within ungulate herds. Mountain lions help maintain the health and viability of ungulate populations by preying on sick individuals, reducing the spread of disease such as brucellosis and chronic wasting disease (CWD). This ecosystem benefit is increasingly important as CWD infection continues to infiltrate ungulate herds in Colorado and neighboring states.[33]

Hunters likely cannot substitute for mountain lions as providers of ecological services such as stopping the spread of disease.[34] During a three-year study on Colorado's Front Range, researchers found that mountain lions preyed on mule deer infected with CWD.[35] The study concluded that adult mule deer preyed upon by mountain lions were more likely to have CWD than deer shot by hunters. According to the study, "The subtle behavioral changes in prion-infected deer may be better signals of vulnerability than body condition, and these cues may occur well before body condition noticeably declines."[36] This suggests that mountain lions select for infected prey and may be more effective at culling animals with CWD than hunters who rely on more obvious signs of emaciation that occur in later stages of the disease. Moreover, the lions consumed over 85 percent of carcasses, including brains, removing a significant amount of contamination from the environment.[37]

The Plan should incorporate leading research on the ecological benefits of mountain lions, acknowledging the role they play as a keystone species by initiating trophic cascades and in helping to prevent the spread of ungulate diseases. Such additions are necessary to better align the Plan with CPW's goals for managing mountain lions for their ecological value, as stated within the executive summary.

VI. Conclusion.

We once again thank CPW for providing this opportunity to share our recommendations on the draft West Slope Mountain Lion Management Plan. While we support an update to CPW's current

management plan, the recommendations outlined above are necessary to improve mountain lion management in Colorado and better align with the values of all residents.[38] Please do reach out if you have any questions. Thank you for your consideration.

Sincerely,

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