



TECHNICAL WORKING GROUP

FINAL SUMMARY OF RECOMMENDATIONS
FOR THE COLORADO WOLF RESTORATION
AND MANAGEMENT PLAN

**Technical Working Group (TWG)
to Colorado Parks and
Wildlife (CPW)**

August 2022

Introduction

This is a final summary and compilation of considerations and recommendations provided by the Technical Working Group (TWG) for the Colorado Wolf Restoration and Management Plan process. The report synthesizes key takeaways from the TWG’s reports on restoration logistics; livestock compensation; state recovery metrics and delisting and down-listing thresholds; and wolf management, as well as cross-cutting themes for all topics. The full-length reports for each topic are included in appendices.

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The Technical Working Group was convened by Colorado Parks and Wildlife and supported with third party facilitation from Keystone Policy Center.



About the Technical Working Group (TWG)

Colorado Parks and Wildlife (CPW) invited technical experts to serve on the Technical Working Group (TWG) to provide and review objective, science-based information as well as provide their own knowledge and experience at the state/federal/Tribal level to inform the development of the Colorado Wolf Restoration and Management Plan. The TWG is composed of members who bring experience in wolf reintroduction, wolf management, conflict minimization, depredation compensation, and other relevant topics.

Colorado Parks and Wildlife (CPW) is responsible for writing the Wolf Restoration and Management Plan. The Parks and Wildlife Commission (PWC) serves as the decision-making body responsible for approving the Wolf Restoration and Management Plan. The TWG serves in an advisory capacity to Colorado Parks and Wildlife, offering non-binding input into the development of plan content. The TWG is not a decision-making body and has no authority on wolf management policy, research, or operations.

TWG considerations and recommendations are based upon members' knowledge and experience in biological science and wolf management. The TWG was not charged with conducting literature reviews but rather drew from its in-depth knowledge of literature in offering insights to inform the plan.

The TWG operates by consensus. For purposes of the TWG, consensus refers specifically to general agreement, or lack of objection, that an option or alternative has sufficient technical merit to be recommended for consideration by CPW. In the absence of consensus, dissenting views are documented to characterize the range of views and/or the range of science, experience, and uncertainties on specific topics. (See Appendix D for the TWG Charter).

The TWG met once monthly via Zoom from June 2021 to August 2022, except for May 2022 and in a joint meeting with the Stakeholder Advisory Group (SAG) December 2021. A total of 14 meetings were held with the TWG, inclusive of the SAG-TWG joint meeting. Meeting summaries were developed and published for each meeting.

Cross-Cutting Themes

The following themes emerged recurrently and consistently throughout the TWG's discussion of restoration logistics; livestock compensation; recovery metrics and delisting and down-listing thresholds; and management considerations.

- Building trust, maintaining relationships, setting expectations, emphasizing transparent and meaningful outreach with stakeholders and the public, and having a consistent, frequent, and determined presence in the field by CPW staff to establish and maintain trust are critical to achieve success in reintroduction and management.
- Both biological/ecological and social/economic dimensions are important to inform Colorado's wolf reintroduction and management plan.
- Allowance of flexibility and adaptation of management both spatially and temporally is important for successful implementation.
- Availability of a full array of management tools to minimize and respond to conflict is critical for working with, addressing impacts to, and assisting affected communities and for providing compensation to individual producers.
- Availability of funding and resources to implement the plan is critical.

- Research and monitoring are important tools to support other aspects of reintroduction and management.
- Wolf reintroduction and management planning is inherently controversial and complex; there is no one solution or silver bullet to meet all goals of all interested groups.
- Colorado has the opportunity to learn and build from past experiences with wolf introduction in other states as well as from its own experiences in wildlife management in developing and implementing a plan to meet Colorado’s specific needs and context.

Summary of Recommendations on Wolf Restoration Logistics

Key takeaways are presented below. See **Appendix E: Final Report on Restoration Logistics** for additional details on these topics as well as for TWG recommendations on: *capture methods at source; what to do with injured animals at source site; age ratios; color ratios; sex ratios; disease issues at sources site; what to feed during a period of captivity; immobilization drugs to be used; where and how to hold animals prior to shipping and upon initial arrival in Colorado; samples collected from animals; veterinarian care in captivity; disease testing and vaccine treatment;* and more details on all topics.

Capture considerations

- **Donor populations:** The alternatives Idaho; Montana; Wyoming; Mix of Northern Rocky Mountain States; Washington; Oregon; Great Lakes; and Mexican Wolves all have technical merit. Idaho, Montana, Wyoming, and a Mix of these Northern Rocky Mountain (NRM) states are recommended as the preferred donor populations, as logistical, source site jurisdiction, and other considerations allow. Planning for all three states and keeping options open and flexible is also recommended both for the initial donor population and for subsequent donor populations as needed. Some TWG members recommend Wyoming as slightly preferred. If these sources are not available, Washington and Oregon are next in preference.
- **Genetic considerations:** The alternatives related pack members; unrelated, dispersing age animals; and mix of packs and unrelated individuals all have technical merit, with highest preference for unrelated, dispersing age animals; followed by preference for a mix of packs and unrelated individuals; and least preference for selecting only related pack members.
- **Animal reputation:** The alternatives “not known to be a depredator,” “wolves that have been around livestock without conflict,” and “wolves that have not been present around livestock at all” all have technical merit as factors for sourcing donors; “known depredator” has technical merit as a criterion for exclusion from sourcing. Sourcing donor populations not known to be depredators (whether present around livestock or not) was preferential to sourcing populations not exposed to livestock, if possible. However, it is important to consider that most wolves overlap areas with livestock, and there is not a way to know the degree of interaction they have had with humans. No wolf should be translocated that has a known history of chronic depredation, and sourcing from geographic areas with chronic depredation events should not occur.
- **Transportation method from source to Colorado:** The alternatives air; ground; and mix all have technical merit, with no group preference among the alternatives; each has situational relevance according to the plan of capture and translocation. Key to success is that capture, transport, and release should occur as quickly as possible to minimize time in captivity and stress on the animals.

Animal handling considerations

- **Collars/marks on animals initially reintroduced into the state:** Alternatives VHF; GPS; mix of VHF/GPS; PIT tags; ear tags (perhaps temporarily when in captivity) all have technical merit; the alternative “no collar” for animals initially reintroduced into the state does not have technical merit. It is preferred that every released wolf has a GPS collar, with variability in durability of GPS collar types as an important consideration. Ear tags are less preferred as compared to the other collaring/marketing alternatives.

Reintroduction considerations

- **Reintroduction technique:** Alternatives hard release; soft release; and a combination of soft and hard release all have technical merit, with hard release preferred to soft release and to a combination of soft and hard release. There are pros and cons to consider for both techniques; however, hard release has greater technical merit as well as greater logistical and economic feasibility and is thus recommended by the TWG as the preferred technique.
- **Time of year for reintroduction:** Alternatives spring and summer do not have technical merit; alternatives winter and fall both have technical merit; and winter is preferred over fall.
- **Considerations for where wolves could be released:** All of the following considerations have technical merit: land ownership; livestock presence; geographic context; prey base; likelihood of supporting multiple packs; proximity to state border; vote results; and seasonal elk supply. Vote results have least preference as a technical alternative to guide reintroduction location, but it is recognized that socio-political considerations will also be at play in selection of release area(s). A site where a wolf is released is not expected to be necessarily where the wolf will stay.
- **Number of release sites (and number of release areas):** The alternatives of flexibility in specific release sites for an area with multiple release points; multiple release areas; and one release area were all determined to have technical merit. The alternative to have flexibility in specific release sites for an area with multiple release points is most preferred.
- **Pace of wolf reintroduction:** All of the following alternatives have technical merit: about thirty to forty wolves reintroduced for one year (fast); about ten to fifteen wolves reintroduced per year for two to three years (medium); about five to ten wolves reintroduced per year for three to six years (slow); and “be flexible” (note: numbers are not concrete and are meant to suggest relative pace). The general technical preference is for a “medium” pace, followed by a “slow” pace, and, least favorably, a “fast” pace. It is important to be flexible and adapt the specific logistics of these paces according to conditions of the reintroduction. It is also important to be adaptive around specific dates and numbers. The overall goal is ultimately to establish a self-sustaining population. The goal of the initial translocation and restoration is to introduce enough wolves at an adequate pace to establish a growing population that can ultimately achieve a self-sustaining population. Without specifying what that might look like from a numerical perspective and/or other indicators, there are a variety of ways (i.e., paces) that could work to achieve a growing population. Note: discussion of this topic focused specifically on the number of wolves actively reintroduced, not long-term population goals or management thresholds.
- **When to stop and/or pause reintroduction:** The following alternatives all have technical merit: after about forty animals have been moved; indication of pack establishment; indication of pack establishment with some documented reproduction; two packs raising two pups for two consecutive years; and a flexible approach (i.e., do releases (e.g., of thirty to forty wolves) and then pause to see what happens) all have technical merit. The preferred option is to do ‘a bunch’ (undetermined number) of releases (e.g., release a total of approximately thirty to forty wolves), then pause, assess, and adapt based on whether the initial restoration phase has resulted in an adequately growing population that will ultimately achieve a self-sustaining population.

Summary of Technical Considerations on Compensation for Wolf Damage to Livestock

Key takeaways are presented below. See **Appendix F: Final Summary of Technical Considerations on Compensation for Wolf Damage to Livestock** for more detail.

- **Social dimensions of compensation plans:** While the TWG provided feedback on technical merit on potential compensation elements, it recognized that there are various social considerations for livestock compensation and thus the Stakeholder Advisory Group (SAG) was charged with leading the development of comprehensive recommendations regarding the compensation plan.
- **Confirmed and probable depredation:** There is TWG consensus that compensation for confirmed depredations at fair market value has technical merit. Compensation for probable depredation has technical merit. A range of compensation amounts (50-100% of fair market value) were suggested as having technical merit; however, lesser amounts (i.e., less than 50%) were not suggested.
- **Compensation ratios/multipliers:** There is TWG consensus that compensation ratios for missing cattle and sheep on public and private lands have technical merit, but there are different perspectives and technical considerations regarding when these ratios should be triggered and how they should be administered. TWG members generally were uncertain as to what an appropriate ratio should be.
- **Indirect losses:** There is TWG recognition of the technical reality of indirect losses. However, there was mixed feedback from the TWG on whether there is technical merit to compensate for indirect losses, as many factors can contribute to indirect losses, particularly as there is not a clear or proven technical approach for quantifying and compensating for indirect losses. Indirect losses include impacts to pregnancy rates, weaning rates, lower weight gains due to stress or increased activity rates, future economic losses (e.g., loss of future production or loss of investments in genetics).
- **Pay-for-presence:** The TWG did not have clear consensus on whether or not pay-for-presence programs have technical merit; they offered a variety of perspectives regarding feasibility, purpose, and efficacy.
- **CPW's current game damage program:** There are various considerations for whether and how the current program should be evolved specifically for wolves. There is general consensus regarding the value of consistency of process; however, there are a variety of opinions on whether there should be differences in compensation eligibility, amount, and/or criteria. Many TWG members suggest technical merit in consistency in using the existing program; however, the TWG also recognizes that there are various social considerations on this topic as well that the SAG will weigh in regarding whether and how the current program should be evolved for wolves.
- **Damage investigations:** Conducting damage investigations via CPW and APHIS-WS has technical merit. Investigators should have adequate training to conduct professional, consistent damage investigations.
- **Funding sources and administration:** TWG perspectives generally support using multiple sources of funding for compensation and other livestock interactions issues, although there were varying perspectives on whether this is a technical issue and/or is an issue with technical merit. Consistency in administration of funds, regardless of sources, was emphasized. Pros and cons of using other agencies as administrators for funding and/or for other elements of the game damage program was also discussed.
- **Non-lethal risk reduction requirements for compensation:** TWG members emphasized the importance of encouraging non-lethal risk reduction techniques; however, there were various perspectives regarding the technical merit and feasibility of requiring their use in order to receive damage compensation. The TWG discussed context-specificity of non-lethal risk reduction practices and losses; importance of maintaining flexibility rather than prescribing practices; difficulty in defining risk reduction requirements; value in strategies to incentivize adoption and creative problem solving; and maintenance of relationships with local producers.

Summary of TWG Recommendations on State Listing and Delisting Thresholds

Wolf Population Listing/Delisting Phased* Framework

The recovery metrics or thresholds outlined in the table below were developed through expert deliberation of TWG members and are presented in a phased framework. While the determination of these thresholds is a technical exercise, management actions corresponding to the phased framework should be informed by legal and social considerations, which will be addressed largely by the Stakeholder Advisory Group (SAG).

	Phase 1 <i>(correlating with state endangered status)</i>	Phase 2 <i>(correlating with state threatened status)</i>	Phase 3 <i>(correlating with state delisted, nongame status)</i>	Phase 4⁺ <i>(correlating with state delisted, game status)</i>
Start	Current (2022)	Minimum count of 50 wolves anywhere in Colorado for four successive years.	Phase 1 and Phase 2 conclusion requirements are both met. Phase 2 requirements may be met concurrently with Phase 1 requirements.***	Discretionary phase, not prescriptive nor legally required. A population estimate above the delisting threshold would be required.
Conclude	Minimum count** of 50 wolves anywhere in Colorado for four successive years.***	Minimum count of 150 wolves anywhere in Colorado for two successive years**** -OR- Minimum count of 200 wolves anywhere in Colorado with no temporal requirement.	No prescribed conclusion; not legally required.	No prescribed conclusion.
Action upon conclusion	Downlist to state threatened.	Delist from Colorado state list	Consider reclassifying to game species.	N/A
Criteria to move back into this phase	After downlisting, a minimum count of less than 50 wolves anywhere in Colorado for two consecutive years initiates review of relisting to state endangered status.	After delisting, a lower bound of a population estimate of less than 150 wolves anywhere in Colorado for two consecutive years initiates review of relisting to state threatened status.	To be determined depending on whether and under what criteria a game reclassification is made.	N/A

Notes on the framework

*Phases will be dictated by numeric and temporal wolf population thresholds described in the table. While it is intended that state status will also correspond to these thresholds, there may be a time lag as the Parks and Wildlife Commission undertakes the procedural process to change the state status based on population counts.

**Minimum population counts in any phase include gray wolves that have been reintroduced to Colorado and those that have naturally migrated into the state and their progeny. Wolf population minimum counts in this table refer to counts conducted in late winter to most accurately reflect recruitment.

***“Successive” means years in a sequence, with any number of gaps in between. Consecutive means years in a sequence with no gaps. The rationale for using a metric of successive years is to account for potential years when an adequate survey cannot be conducted.

****Downlisting to state threatened status may not occur until the four-successive year requirement is met in the state endangered status (Phase 1). However, the two-successive year timeline for the Phase 2 minimum count requirement begins when the minimum number is first met and may occur concurrently while in the Phase 1/endangered phase. Consequently, it is possible that delisting (conclusion of Phase 2) may occur immediately after Phase 1, should the Phase 2 requirements be met concurrently during Phase 1.

† The TWG’s inclusion of Phase 4 in the above table does not indicate a TWG consensus recommendation on whether or not Phase 4 should occur; it is intended to demonstrate that phased approaches may potentially include a Phase 4 (classification as a game species). The TWG recognized that determination of whether to move to game classification should consider a variety of information and perspectives and will also be informed by legal considerations including interpretation of authorities relative to the definition of gray wolves in CRS 33-2-105.8 as being a nongame species. Many TWG members support Phase 4; however, one TWG member opposed Phase 4 and also suggested that the Phase 4 column is redundant with information already described in Phase 3.

See **Appendix G: Final Report on Technical Recommendations for Colorado State Listing/Delisting Thresholds and Phasing** for more detail.

Summary of TWG Technical and Experiential Feedback on Wolf Management Considerations

See **Appendix H: Final Report on Technical and Experiential Feedback on Wolf Management Considerations** for more detail on each of the summary points below.

- **Conflict-centered management vs. objective-based management:** Wolf management should focus on management of conflict, with consideration of the social factors that accompany an impact-based management approach. Lessons from other states with wolves suggest population management is not robustly correlated with conflict minimization. Generally, the public has a high expectation that state wildlife agencies will address wildlife related challenges.
- **Avoiding misinterpretation of maximum vs. minimum population metrics:** It is important to use clear and consistent messaging to reinforce the purpose of minimum population counts/estimates, which are not intended as population objectives or maximums and have been misinterpreted in other contexts.
- **Zonal management:** Initial and long-term management should be impact-based. Zonal management of conflict could be a consideration for future management. Delineation of zones in the future could be informed by experience and data gathered through impact (and conflict)-based management, understanding of ecological and social suitability (inclusive of wildlife and agricultural interests), and learnings from wolf dispersal and establishment on the ground.
- **Wolf population self-regulation:** Intrinsic self-regulation of wolves is unlikely at a statewide scale; wolves will likely be extrinsically regulated particularly by social carrying capacity. Wolf population self-regulation does not achieve the same goals as conflict management.
- **Positive impacts and wolf management:** Positive and negative impacts can occur due to wolf presence; positive impacts do not generally require hands-on management but can be communicated through education and outreach and can inform management activities and funding opportunities.
- **Non-lethal livestock conflict minimization:** Adoption of proactive and reactive non-lethal conflict risk reduction techniques by livestock producers in Colorado is important to the long-term success of the wolf restoration and management program. The effectiveness of these tools is context-specific and not well quantified.
- **Post-depredation management of conflict wolves:** While wolf depredations on livestock in other states are uncommon and do not represent a notable burden to the livestock industry as a whole, some wolves do cause significant problems for some ranchers and some areas experience repeated and frequent wolf depredations on livestock. Management of wolf-livestock conflicts following depredations should allow flexibility for managers; non-lethal and lethal management techniques should be applied adaptively and are context-specific. To be effective at reducing further depredation events, lethal and non-lethal responses for resolving conflict should be applied quickly and properly. Relocation of depredating wolves has little technical merit.
- **Lethal management of conflict wolves:** Lethal and non-lethal management are both critically important tools for conflict minimization; lethal management will likely attract greater social attention. In evaluating the management approach on a context-specific basis, consider the trade-offs among ability to target depredating wolves, conflict minimization efficacy, cost, reproductive and recruitment success, wolf population size and listing status, impacts to livestock producers, and social/stakeholder interests when considering lethal take options, including incremental and whole pack removal.
- **Considerations for ecological effects:** Ecological function is an important factor to consider but is difficult to quantify and may be less relevant as a metric at the state scale.
- **Impacts of wolves to ungulates, big game, and big game hunting:** Although statewide impacts to ungulate populations and hunting opportunities have not occurred in other states and are unlikely in

Colorado, wolves can have local impacts to ungulate recruitment due to predation of young ungulates. Wolves prefer elk and will also prey on deer and other ungulates; moose may be targets of predation where they are abundant. Reduction in big game hunting opportunities and targeted wolf control have sometimes occurred locally in other states to address negative ecological or economic effects of reduced ungulate populations. Ungulate populations are impacted by a complexity of interacting factors.

- **Impacts of wolves to prey compromised by infectious disease:** Predators like the gray wolf may select for prey compromised by infectious diseases, which could prove useful in reducing infectious disease prevalence in ungulate populations, primarily when pathogens are directly transmitted among hosts. The strength of a potential disease reduction depends on numerous factors, including specific disease etiology, the strength of selection for infectious individuals, and overall predation rates. It is unclear whether wolves will have a measurable effect on chronic wasting disease (CWD) in Colorado, where environmental contamination is likely to be a primary transmission route and where CWD is already well-established in mule deer, a species that wolves generally do not select for in the presence of elk.
- **Interactions with other wildlife species:** Wolves are important components of trophic networks where they are present on the landscape and their presence may have interactions with other large carnivores. The presence of wolves will not have an impact on populations of threatened and endangered species in Colorado, specifically lynx and Gunnison sage grouse.
- **Management of conflict with humans:** Attacks by wolves on humans are exceedingly rare; education and outreach for recreationists and other public lands users should include best practices and guidance, including how to differentiate wolves and coyotes. Flexibility to address rare instances of wolf habituation in areas dominated by humans is important.
- **Management of conflict with pets and hunting dogs:** Wolf attacks on pets are uncommon; education, outreach, and management should be used to proactively prevent conflict. It is important that public messaging emphasizes the risks assumed when domestic and hunting dogs are present in areas with wolves.
- **Wolf monitoring and expectations for stakeholders and public:** Monitoring and research should be based on restoration and management goals, use a variety of techniques, and be connected to other elements of wolf management, including conflict minimization. While robust monitoring is valuable at early stages of reintroduction, limitations to monitoring will increase with wolf population growth, requiring transition to a population estimate approach. It is important to consider effective messaging and coordination with stakeholders and the general public when communicating monitoring objectives and data; lead with trust and share data on an as-needed basis.
- **Social and/or economic dimensions of wolf management:** Social and economic dimensions are critical to understand, measure, and incorporate into decisions on wolf management. Perceptions of wolves and perspectives on management vary among people, are generally consistent within interest groups, and often reflect deeply held beliefs and values. There is high potential for social controversy and conflict, particularly as related to expectations and acceptance for use of non-lethal practices, lethal control, recreational harvest/regulated public hunting, and wolf population numbers. Some research suggests that economic benefits can be substantial and much larger than economic costs; however, economic benefits and costs are not distributed equally across stakeholders and the public. Consider the breadth of existing social science research, economic indicators, and stakeholder and public feedback when making management decisions, and incorporate new social and economic research into future decisions. Education and outreach can also inform and be informed by social science. It is critical to have trusted, responsive managers on the ground and consistency of management.

Appendix A: Technical Working Group Members

Scott Becker	U.S. Fish and Wildlife Service, Regional Wolf Coordinator
Alan Bittner	Bureau of Land Management, Deputy State Director
Stewart Breck	National Wildlife Research Center U.S. Department of Agriculture, Research Wildlife Biologist
Roblyn Brown	Oregon Department of Fish and Wildlife, Wolf Program Coordinator
Wayne East	Colorado Department of Agriculture, Agricultural/Wildlife Liaison
Justin Gude	Montana Fish Wildlife and Parks, Research and Technical Services Bureau Chief
Jonathan Houck	Gunnison County Commissioner
Mike Jimenez	U.S. Fish and Wildlife Service, Retired
Merrit Linke	Grand County Commissioner
Steve Lohr	U.S. Forest Service, Rocky Mountain Region Renewable Resources Director
Carter Niemeyer	U.S. Fish and Wildlife Service, Retired
Martin Lowney	U.S. Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services, State Director
Eric Odell	Colorado Parks and Wildlife, Species Conservation Program Manager
Mike Phillips	Rocky Mountain Wolf Project, Founder/Turner Endangered Species Fund, Executive Director
John Sanderson	Colorado State University Center for Collaborative Conservation, Director
Doug Smith	National Park Service, Yellowstone National Park, Senior Wildlife Biologist
Robin Young	Colorado State University Extension Service, Archuleta County Extension, Director, Natural Resources and Agricultural Agent

The Technical Working Group was supported with third party facilitation from Keystone Policy Center and with additional staff support from Colorado Parks and Wildlife.

Appendix B: Technical Working Group Member Biographies

Scott Becker, U.S. Fish and Wildlife Service, Wyoming Wolf Coordinator

Scott Becker is the Region 6 Wolf Coordinator for the U.S. Fish and Wildlife Service (USFWS) based in Lander, Wyoming. Scott has been involved with large carnivore (grizzly bear, black bear, mountain lion, and wolves) management since 2000 when he began working as a large carnivore biologist for the Wyoming Game and Fish Department (WGFD). Scott switched to strictly wolf management in 2008, working for both WGFD and then the USFWS, where he coordinated and directed wolf management activities around Cody, Wyoming between 2008 and 2012. Scott was the statewide wolf specialist for the Washington Department of Fish and Wildlife from 2012 to 2017, where he coordinated and directed field activities related to wolf recovery and management in the state prior to returning to Wyoming to serve in his current role. Scott received his B.S. in Wildlife and Fisheries Biology and Management in 1997 and his M.S. in 2008, both from the University of Wyoming. His M.S. research evaluated factors limiting population growth of the north Jackson moose herd in Wyoming.

Alan Bittner, Bureau of Land Management (BLM), Deputy State Director, Resources

Alan Bittner serves as the Deputy State Director for Resources and Planning at the BLM State Office in Colorado. The division provides guidance and policy direction to the four districts and ten field offices within BLM Colorado's 8.3 million acres. The division includes all biologic resources, wild horses, water rights, and cultural resource management. In addition, statewide planning guidance and recreation management are led out of the division. Previous to arriving in Colorado, Alan most recently served as the Northern California District Manager in Redding, California since 2017 where he oversaw four field offices in a district that stretched from the coast to NW Nevada. Alan served as the Anchorage Field Manager, where he oversaw 24 million acres of BLM-administered public lands in western, south-central, and southeast Alaska. Alan also served as an Assistant Field Manager in Carson City, Nevada for four years where he oversaw the forestry, range, recreation, wildlife and wild horse and burro programs. Alan began his career in Idaho where he worked for the U.S. Forest Service and BLM for 15 years. He has a bachelor's degree in biology from Cornerstone University in Michigan and he enjoys getting outdoors with his wife Monique and their two boys.

Stewart Breck, National Wildlife Research Center, Research Wildlife Biologist

Dr. Stewart Breck, Research Wildlife Biologist, is a researcher for the USDA-National Wildlife Research Center and his research is focused on carnivore ecology and behavior and minimizing conflict between carnivores and people. Studies include testing nonlethal methods for preventing conflict, measuring the impact of carnivores on livestock, influence of urban environments on carnivore ecology, and population biology and behavioral ecology of carnivores.

Roblyn Brown, Oregon Department of Fish and Wildlife, Wolf Program Coordinator

Roblyn graduated from The Ohio State University with a B.S. in 1993, then moved west as fast as she could. She worked on various carnivore (grizzly bear, mountain lion, lynx) and endangered species projects in CO, MT, ID, and Alberta for various NGOs, states, and federal government before moving to Oregon to monitor bighorn sheep in Hell's Canyon. For the last 12 years, Roblyn has been working for the Oregon Department of Fish & Wildlife (ODFW) implementing the Oregon Wolf Conservation and Management Plan. She arrived in Oregon about the time wolves were naturally recolonizing Oregon and has monitored the population as it has grown from 14 to 173 and expanded across the state. She has been the statewide coordinator since 2016, with responsibilities coordinating and directing capture, population monitoring, evidence-based depredation investigations, wolf-conflict response, and information and education.

Wayne East, Colorado Department of Agriculture, Agricultural/Wildlife Liaison

Wayne was born in La Junta and is a fifth-generation native Coloradan. Wayne has a B.S. in Wildlife Biology from Colorado State University and a Master of Public Administration from the University of Colorado at Denver. Wayne has enjoyed a diverse career in wildlife management and has served as the Wildlife Programs Manager at the Colorado Department of Agriculture since 2014. Wayne oversees programs that impact the agriculture and wildlife interface including Chronic Wasting Disease, Aquaculture, and Depredation. Wayne's honors include receiving the 2018 Wildlife Professional of the Year award from the Colorado Trappers and Predator Hunters Association, and the 2020 Friend of the Industry Award from the North American Elk Breeders Association.

Justin Gude, Montana Fish Wildlife and Parks, Research and Technical Services Bureau Chief

Justin Gude has been the Wildlife Research & Technical Services (RTS) Bureau Chief for Montana Fish, Wildlife & Parks (FWP) since 2008. The RTS Bureau consists of wildlife research, health, biometrics, and survey programs, and their work covers a variety of taxa ranging in size from songbirds and bats to moose, in all corners of the state. Justin is responsible for overseeing the work of the RTS Bureau and ensuring integration of the wildlife research and management programs at FWP. Justin has been involved in wolf predator-prey, population dynamics, monitoring, harvest, and depredation research and management for 25 years. He has an M.S. in Fish & Wildlife Management from Montana State University and a B.S. in Wildlife Ecology and Conservation from the University of Florida.

Jonathan Houck, Gunnison County, County Commissioner

Jonathan Houck was recently elected to this third term and is chair of the Gunnison County Board of County Commissioners. Prior to serving in his role as commissioner, he was Mayor of the City of Gunnison. A 30-year resident of Gunnison and graduate of Western Colorado University, he has spent his professional life as an educator before being elected commissioner. He is deeply involved and experienced in public lands and wildlife issues. He formed and led the County Coalition for the Gunnison Sage Grouse, a collaborative of ten southwest Colorado counties and one southeast Utah County working to improve habitat and opportunities for recovery of the species. He has worked with numerous regional and statewide stakeholder groups, agricultural producers, conservation organizations, and outdoor recreational advocates in his time as commissioner and has been a reliable bridge builder when working on challenging issues.

Mike Jimenez, U.S. Fish and Wildlife Service, Wolf Biologist, Retired

Mike Jimenez was a wolf biologist for 30 years, beginning in 1986. He has a master's degree in wildlife biology from the University of Montana. Most of Jimenez's career was with the USFWS in Wyoming, Montana, and Idaho. He was a field biologist and the project leader for wolf recovery in Wyoming for eighteen years and project leader for the entire Northern Rocky Mountains (NRM) for five years. He also served as the wolf project leader for the Nez Perce Tribe to reintroduce wolves into Idaho in 1995-96. Jimenez was also the project leader for the Wyoming Game and Fish Department when wolves were briefly delisted in 2008. In addition to field work, his responsibilities included research and management publications in scientific journals, presentations at scientific symposiums and government agencies, articles and presentations to special interest groups, and working directly with the U.S. Department of Justice to delist wolves in the NRM. Jimenez retired in 2016.

Merrit Linke, Grand County Commissioner

Merrit Linke is part of a 5th generation ranch family and Grand County native. He lives on the original 160 acres that was homesteaded in 1883 by his great-grandfather. He graduated from Middle Park High School in Granby, from Northeastern Junior College in Sterling, and from the University of Wyoming in 1985 with a B.S. degree in secondary education with a major in physics and minors in chemistry and earth science. From 1987-2001, he taught all levels of science, mostly chemistry and physics, and coached multiple levels of several sports ranging from 7th-grade girls' basketball to intercollegiate rodeo. He started a livestock feed and supplement business in

2001, worked for the livestock nutrition division for an international company and continued with his own feed distribution business until selling it in 2018. Merritt was elected Grand County commissioner in 2012 and was re-elected in 2016 and 2020. He is currently chair of the Board and serving his 3rd term. He also currently serves on the executive committee of Club 20; served as CCI Mountain diarist president for 3 years and currently serves as vice president of Middle Park Stockgrowers. He is a member of the Bureau of Land Management Resource Advisory Council (RAC) and serves as vice-chair of the Grand County Wildfire Council. Since 1999, he has owned and operated a livestock and hay production business in Grand country and continues to operate it today.

Steve Lohr, United States Forest Service, Renewable Resources Director, Rocky Mountain Region

Steve grew up in Beaufort, South Carolina where he became fascinated with coastal ecology at an early age. He received his bachelor's degree in biology from Lander University in Greenwood, SC in 1994. Steve was accepted to graduate school at Clemson University in 1997 (Go Tigers!), where he earned his master's degree in zoology in 1999. Following graduation, Steve accepted a position as a wildlife biologist with the South Carolina Department of Natural Resources where he served as the SC red-cockaded woodpecker recovery coordinator. In 2001, Steve took a position as a wildlife biologist with the US Air Force at Shaw Air Force Base in Sumter, South Carolina where he was responsible for wildlife management of a 16,000-acre bombing range. Steve began his career with the Forest Service in 2002 when he accepted the district wildlife biologist position on the Francis Marion National Forest in South Carolina. At the end of 2005, Steve began working as the forest wildlife biologist on the Tonto National Forest in Phoenix, Arizona. Steve was the District Ranger on the Cheoah and Tusquee Ranger Districts on the Nantahala National Forest from 2008 to 2011 where he focused on large scale watershed restoration efforts and completing \$7million of ARRA projects that focused on economic recovery of local communities. Steve was the Forest Supervisor in Alabama from 2011 to 2014 where he enjoyed the challenges of making decisions on a landscape scale and working with an outstanding group of natural resource professionals and partners. Steve was the Director of the National Partnership Office in Washington, DC from 2014 to 2016 where he worked to build the agency's capacity surrounding partnerships as well as maintain and develop new national level partnerships. Steve is currently the Director of Renewable Resources for the Rocky Mountain Region and has responsibility for the forest management, wildlife, range, water, and air programs. Steve has a wife, Stacy, and three children, Malia (19), Sam (17), and Will (14). They spend free time enjoying all outdoor activities including hiking, biking, skiing, and camping.

Martin Lowney, U.S. Department of Agriculture, Wildlife Services, Animal and Plant Health Inspection Service, State Director

Martin Lowney has worked for 34 years as a wildlife damage management biologist for the United States Department of Agriculture, Wildlife Services program. He has been the state director for the Wildlife Services programs in Colorado, New York, and Virginia and held other positions in Mississippi, Alabama, and other states. He is a Certified Wildlife Biologist by The Wildlife Society and serves as an editorial advisory board member for *The Professional*, a news journal published by The Wildlife Society. Martin Lowney earned his Master of Science degree in wildlife management from Mississippi State University and a Bachelor of Science degree in natural resource management from the University of Massachusetts. His job duties have been working with local and state governments, federal agencies, organizations, and individuals to develop and implement projects to reduce damage caused by wildlife to protect agriculture, human health and safety, natural resources, and property. Martin has broad experience working with the livestock industry to alleviate predation on sheep, goats, and cattle from coyotes, bears, mountain lions, and wolves. Additionally, he has lead projects for the restoration of shorebirds on the Atlantic coast and other wildlife depredated by native and non-native wildlife. Martin has published two training manuals on managing predation to livestock. Lastly, he has written grants for state wildlife agencies and non-governmental organizations for funds to conduct research on predation or to manage predation on native wildlife species.

Carter Niemeyer, U.S. Fish and Wildlife, Idaho Wolf Recovery Manager, Retired

Carter Niemeyer has Bachelor of Science (1970) and Masters (1973) degrees in wildlife biology from Iowa State University. He was a state trapper for the Montana Department of Livestock, and a district supervisor for USDA Wildlife Services in western Montana managing and controlling large predators. He was chosen as the wolf management specialist for USDA Wildlife Services covering the states of Idaho, Montana, and Wyoming. In that position, he was responsible for livestock depredation investigation, as well as wolf capture and removal. Niemeyer was a member of the wolf capture team in Canada during reintroduction in the mid-1990s. In 2001 he was recruited by the U.S. Fish and Wildlife Service to run the agency's wolf recovery program in Idaho, and retired in 2006, coincidentally on the same day that wolf management was officially handed over to the state of Idaho. He also has worked on wolf issues in Washington, Oregon, California, and Colorado, as well as England, Scotland, France, and Kyrgyzstan. He wrote his first memoir, *Wolfer*, in 2010. His second memoir, *Wolf Land* was published in 2016. Carter lives in Boise, Idaho with his wife, Jenny.

Eric Odell, Colorado Parks and Wildlife, Species Conservation Program Manager

Eric grew up in Colorado and gained a strong appreciation of the outdoors from an early age. He attended Middlebury College in Vermont, traveled extensively for a variety of field jobs and then began graduate school at Colorado State University where he completed his graduate degree in wildlife biology. He began working for the Colorado Division of Wildlife in 2000. He has worked for that agency, now Colorado Parks and Wildlife, in a variety of capacities since then - as a Habitat Biologist based in an NRCS field office, as a Conservation Biologist, as the Grassland Coordinator, and now as the Species Conservation Program Manager for Carnivores. In this role he directs conservation and management programs to aid in the establishment and protection of native, non-game carnivore species to the state. He is the biological lead for the wolf reintroduction effort for Colorado Parks and Wildlife.

Mike Phillips, Rocky Mountain Wolf Project, Founder/Turner Endangered Species Fund, Executive Director

Mike received his M.S. in wildlife ecology from the University of Alaska in 1986 and his B.S., ecology from the University of Illinois in 1980. He has served as the Executive Director of the Turner Endangered Species Fund and advisor to the Turner Biodiversity Divisions since he co-founded both with Ted Turner in June 1997. Since inception, the organizations have stood as the most significant private effort in the world to redress the extinction crisis through active reintroduction efforts on behalf of imperiled species. From 1985 through May 1997, Mike worked for the U.S. Department of Interior leading historic efforts to restore red wolves to the southeastern US and gray wolves to Yellowstone National Park. Mike has served on recovery teams for several species (e.g., ivory-billed woodpecker, black-footed ferret, red wolf, Mexican gray wolf) and has conducted important research on the impacts of oil and gas development on grizzly bears in the Arctic National Wildlife Refuge, predation costs for gray wolves in Alaska, and dingo and red fox ecology in Australia. From 2006 through 2020 Mike served in the Montana House of Representatives and Montana Senate. In 2014, Mike founded and led Rocky Mountain Wolf Project and Rocky Mountain Wolf Action Fund to use direct democracy to establish a lawful mandate to restore wolves to western Colorado. By November 2020, the work of both organizations had led to 1,590,299 votes being cast in favor of Proposition 114 and its subsequent passage. In 2021, Mike was selected as the Aldo Leopold Memorial Award recipient, the highest honor bestowed by the Wildlife Society.

John Sanderson, Colorado State University, Director, Center for Collaborative Conservation

John Sanderson is the Director of the Center for Collaborative Conservation at Colorado State University. At the Center, John and his staff work to build the capacity of organizations, communities, and future leaders to achieve conservation impact, while applying CSU's world-class research and education. John has been doing conservation work in the West for over 25 years, including at the Colorado Natural Heritage Program and at The Nature Conservancy, where as Director of Science he led a staff striving to protect land, manage rivers, restore forests, and mitigate and adapt to our changing climate. John earned a B.S. in engineering from Purdue

University, an M.S. in botany from the University of Vermont, and a Ph.D. from the Graduate Degree Program in Ecology at Colorado State University.

Doug Smith, National Park Service, Senior Wildlife Biologist, Yellowstone National Park

Douglas W. Smith Ph.D. is a Senior Wildlife Biologist in Yellowstone National Park. He supervises the wolf, bird, and elk programs – formerly three jobs now combined into one under Doug’s supervision. His original job was the Project Leader for the Yellowstone Wolf Project which involved the reintroduction and restoration of wolves to Yellowstone National Park. He helped establish this project and position. Doug received a B.S. degree in Wildlife Biology from the University of Idaho in 1985. While working toward this degree he became involved with studies of wolves and moose on Isle Royale with Rolf Peterson, which led to long-term involvement (1979-1994) with this study as well as a M.S. degree in biology under Peterson at Michigan Technological University in 1988. He then moved to the University of Nevada, Reno where he received his Ph.D. in ecology, evolution, and conservation biology in 1997 under Stephen H. Jenkins. He has published a wide variety of journal articles and book chapters on beavers, wolves, and birds and co-authored four popular books on wolves (*The Wolves of Yellowstone* and *Decade of the Wolf* which won the 2005 Montana book award for best book published in Montana) as well as publishing numerous popular articles. The third book, *Wolves on the Hunt*, came out in May 2016 and his fourth book *Yellowstone Wolves* came out in December 2020 and summarizes the first 25 years of wolf recovery. He has participated in numerous documentaries about wolves for National Geographic and British Broadcasting Company (BBC) and recently on CBS 60 Minutes as well as other media and done about 2000 media interviews. He is interviewed widely and speaks often about wolves to audiences all over the world. He also recently gave a TEDx talk on wolves. He is a member of the Mexican Wolf Recovery Team, the Re-Introduction Specialist Group, and Canid Specialist Group for the IUCN. Doug has studied wolves for 42 years. Besides wolves, birds, elk, and beavers, he is an avid canoeist preferring to travel mostly in the remote regions of northern Canada with his wife Christine and their two sons Sawyer and Hawken.

Robin Young, Colorado State University Extension Service, Archuleta County Extension Director, Natural Resources and Agricultural agent

Robin Young is the Archuleta County Extension Director, Natural Resources and Agricultural agent. She works closely with landowners, large and small, to define objectives using holistic methods to reach their goals. She started out her career in Flagstaff, AZ, where she attended Northern Arizona University and received a Bachelor of Science in forestry. She worked for the United States Forest Service on the Coconino National Forest for six years before moving to Colorado in 1995. She worked in fire, silviculture, range, and recreation during her time with the USFS and gained a broader knowledge in those resource areas. After moving to Colorado, she ran a private forestry business for 20 years. The primary focus for the business was forest health and fire mitigation. She has also worked as a Conservation District Manager and a range technician for the NRCS. Robin is in her 11th year with Extension and serves the communities of Archuleta County, the San Juan Basin region, and other communities around the state. She works with collaborative groups in the region and across the state. She served as the lead for the Natural Resources planning and reporting unit that led to a collaboration with the Center for Collaborative Conservation, the Center for Human Carnivore Coexistence, APHIS, and the Warner College of Natural Resources to address wolf education in Colorado. They published the Wolf Information booklet for the public. She will be facilitating the training efforts for Extension agents on their needs and the needs of their community members. Her expertise lies with communications and collaborations as a convener and a connector with people.

Appendix C: Technical Working Group Meeting Dates

Date(s)

- June 15, 2021
- July 20, 2021
- August 18, 2021
- September 15, 2021
- October 20, 2021
- November 17, 2021
- December 14-15, 2021
- January 19, 2022
- February 16, 2022
- March 11, 2022
- April 14, 2022
- June 15, 2022
- July 20, 2022
- August 17, 2022

All meetings were held virtually via Zoom with the exception of the joint meeting with the SAG in December 2021, which was held in Denver.

Appendix D: Technical Working Group Charter



**Colorado Wolf Restoration and Management Plan
Technical Working Group
to Colorado Parks and Wildlife**

**Governance Charter
6/8/21**

I. Purpose and Scope of the Technical Working Group

The purpose of the Technical Working Group (TWG) is to review objective, science-based information as well as provide its own knowledge and experience at the state/federal/tribal level to inform the development of the Colorado Wolf Restoration and Management Plan. The TWG is composed of members who bring experience in wolf reintroduction, wolf management, conflict minimization, depredation compensation, and other relevant topics. Colorado Parks and Wildlife (CPW) staff will synthesize information, relevant research, and lessons from other locations and develop draft language and/or alternatives that will undergo internal CPW review. This draft language and/or alternatives will then be shared with the TWG for review and assessment of technical legitimacy for inclusion in the Plan. The TWG may also provide input to CPW on language or alternatives with technical merit that could be utilized to address feedback of the Stakeholder Advisory Group. In gathering feedback from the TWG on draft language and/or alternatives, CPW may utilize subgroups comprised of members of the TWG, and/or may consult with additional experts from outside of the TWG for insight into specific topic areas where specific knowledge may be lacking in the current TWG membership.

II. Governance

This document constitutes the TWG governance charter. The charter is approved by and may be amended by the CPW Director, including with consideration of input from the TWG.

III. Powers and Duties

CPW is responsible for writing the Wolf Restoration and Management Plan. The Parks and Wildlife Commission (PWC) serves as the decision-making body responsible for approving the Wolf Restoration and Management Plan. The TWG serves in an advisory capacity to Colorado Parks and Wildlife, offering non-binding input into the development of plan content. The TWG is not a decision-making body and has no authority on wolf management policy, research or operations. Upon completion of the plan, the TWG will be formally disbanded.

IV. Operating principles and responsibilities

Operating principles and responsibilities of members include:

- a.** Compliance with all aspects of this governance charter.
- b.** Members will demonstrate composure and respect working with those with different experiences, backgrounds and perspectives.
- c.** Members will demonstrate the ability to engage productively and in good faith in the TWG's business and provide timely input.
- d.** Members will demonstrate willingness and preparedness to engage in TWG meetings.
- e.** Members will demonstrate focus on the scope and charge of the group.
- f.** Members will refrain from behavior or comments that denigrate other TWG members or others involved in wolf restoration and management efforts, or are disruptive to the charge and progress of the group.
- g.** Members will treat all draft documents and deliberative communications received or generated by the TWG and its members as confidential and will not disclose their contents except through the reporting procedures discussed below.

V. Membership and Participation

a. Members

Members of the TWG are appointed by the CPW Director. TWG members bring to bear their individual expertise and the expertise of their agencies, departments, and/or fields of practice and study.

b. Resignation of TWG Members

Any member who is no longer able to participate on the TWG shall notify the CPW Director as soon as practicable.

c. Removal of TWG Members

A member may be removed from the TWG at the discretion of the CPW Director based on conduct or lack of participation.

d. Vacancies

If a vacancy occurs on the TWG, the CPW Director may appoint a member to fill the vacant position.

e. Meeting attendance

No TWG member may send a delegate to represent them at any meeting. Meetings will typically occur virtually. TWG and TWG subgroup members shall make best efforts to attend TWG and subgroup meetings in person when meetings are conducted in person, but virtual options will be provided.

VI. Consensus

a. Consensus

The TWG shall operate by consensus. Consensus is defined as general agreement that is shared by all the people in a group; it reflects a recommendation, option or idea that all

participants can support or abide by, or, at a minimum, to which they do not object. In other words, consensus is a recommendation, option or idea that all can live with.

For purposes of the TWG, consensus refers specifically to general agreement, or lack of objection, that an option or alternative has sufficient technical merit to be recommended for consideration by CPW. In the absence of consensus, dissenting views will be documented.

	Consensus exists if <u>ALL</u> participants are at level 1-3:
1	I enthusiastically support this recommendation, option or idea.
2	I support this recommendation, option or idea.
3	I do not fully agree with the decision, however I can abide by or live with this recommendation, option, or idea; I do not object.
4	I object to this recommendation, option or idea.
5	I strongly object to this recommendation, option or idea; I cannot support, live with or abide by it.

b. Reports

The TWG shall provide to CPW a summary report of feedback on draft plan language or alternatives, including technical rationale, relevant considerations, and any concerns or uncertainties regarding technical merit of the draft language or alternatives. The report shall be developed by the facilitator with input and review by the TWG. Interim reports on specific topics, options or alternatives may be provided by the TWG to CPW throughout the process. A final report authored by the TWG will compile interim and final feedback on all topics from the TWG to CPW.

VII. Technical Working Group Subgroups

a. Subgroup Membership

CPW, in consultation with the TWG, may establish *ad hoc* subgroups comprised of TWG members. The TWG and/or subgroup members may consult with additional experts from outside of the TWG for insight into specific topic areas where specific knowledge may be lacking in the current TWG membership.

b. Charge to Subgroups

CPW, in consultation with TWG, shall issue a specific, written charge to each subgroup including the scope of work, timeline of the subgroup, desired work product and manner of work, and reporting requirements.

c. Report of Subgroups

Any draft or preliminary options or alternatives, or feedback on draft plan language or alternatives, presented by a subgroup to the TWG subgroup shall be accompanied by a summary of technical rationale and relevant considerations, including any relevant concerns or uncertainties regarding technical merit.

VIII. Meetings and Records

a. Regular Meetings

CPW shall establish a schedule for TWG meetings in consultation with the facilitators. The TWG shall meet one day a month on average. Additional meetings will be called as necessary by CPW. Subgroups shall meet on an *ad hoc* basis as determined necessary to fulfill their obligations. The TWG does not have authority to adopt rules or create policy and is not subject to the Colorado Open Meetings Law.

b. Facilitation

The CPW Director will contract facilitators to facilitate the work of the TWG and subgroups. CPW staff person(s) will be appointed to coordinate with facilitators in the development of schedules, agendas, materials, and processes for the TWG.

c. Conduct of Meetings

The facilitator will manage meetings of the TWG in the most informal manner possible.

d. Minutes

Minutes shall be kept of all TWG and subgroup meetings and shall include at least names of all TWG members present, the location of the meeting (physical location or virtual meeting), and a summary of the issues or matters discussed. Minutes shall be kept by the facilitator and posted to the TWG website.

e. Open Records

Any records received by the TWG and/or CPW may be subject to the Colorado Open Records Act.

IX. Communication

The CPW Director or his/her designee within CPW shall be the official spokesperson regarding the TWG process. The CPW Director or designee shall be responsible for managing the communications regarding the TWG, including to the media, legislators, the Governor and other policy makers.

TWG members are free to discuss the TWG work with any interested party, but in so doing must clarify they are speaking for themselves, and not the TWG, and must abide by the confidentiality provision above regarding draft and deliberative materials. TWG members are urged to use discretion when discussing the group. Consistent with operating principles, members will refrain from communications that denigrate other participants or are disruptive to the charge and progress of the group.

X. Compensation

Members of the TWG may be offered a nominal stipend and reimbursement for necessary travel expenses incurred in the performance of their duties and in accordance with state government guidelines, when requested.

Appendix E: Final Report on Wolf Restoration Logistics Recommendations

**Colorado Wolf Restoration and Management Plan
Technical Working Group (TWG)
to Colorado Parks and Wildlife (CPW)**

**Final Report on Wolf Restoration Logistics Recommendations
November 2021**



(Photo credit: National Park Service)

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to Colorado Parks and Wildlife (CPW)
November 2021
Final Report on Restoration Logistics**

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**Colorado Wolf Restoration and Management Plan
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to Colorado Parks and Wildlife (CPW)
November 2021
Final Report on Restoration Logistics**

Introduction

This report summarizes Wolf Restoration & Management Plan Technical Working Group¹ feedback to date regarding options for the following restoration logistics, with discussion of 1) technical merit of each option, 2) technical preference among options, and 3) additional considerations:

1. **Capture considerations:** Donor populations; Capture methods at source; Age ratios; Color ratios; Sex ratios; Genetic considerations; Animal reputation; What to do with injured animals at source site; Transportation method from source to Colorado
2. **Animal handling considerations:** Feed options; Where and how to hold animals prior to shipping and upon initial arrival in Colorado; Immobilization drugs to be used; Collars/marks on animals initially reintroduced into the state; Samples collected from animals; Veterinarian care in captivity; Disease testing and vaccine treatment
3. **Reintroduction considerations:** Reintroduction technique; Time of year; Considerations of general landscape characteristics where wolves could be released; Pace of wolf reintroduction; When to stop and/or pause reintroduction Number of release sites (and number of release areas)

Capture considerations

Donor populations

Alternatives considered: Idaho; Montana; Wyoming; Mix of Northern Rockies States; Washington; Oregon; Great Lakes; and Mexican Wolves

Capture and translocation of wolves from other states for translocation to Colorado will require authorization by the respective state wildlife Commission or agency Director. A decision process in the donor jurisdiction(s) will be required for such a project, which will need to be initiated well in advance of project initiation.

¹ **About the TWG:** The purpose of the Technical Working Group (TWG) is to review objective, science-based information as well as provide its own knowledge and experience at the state/federal/tribal level to inform the development of the Colorado Wolf Restoration and Management Plan. The TWG is composed of members who bring experience in wolf reintroduction, wolf management, conflict minimization, depredation compensation, and other relevant topics. CPW is responsible for writing the Wolf Restoration and Management Plan. The Parks and Wildlife Commission (PWC) serves as the decision-making body responsible for approving the Wolf Restoration and Management Plan. The TWG serves in an advisory capacity to Colorado Parks and Wildlife, offering non-binding input into the development of plan content. The TWG is not a decision-making body and has no authority on wolf management policy, research, or operations. The TWG operates by consensus. For purposes of the TWG, consensus refers specifically to general agreement, or lack of objection, that an option or alternative has sufficient technical merit to be recommended for consideration by CPW. In the absence of consensus, dissenting views will be documented.

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Summary of TWG feedback: All alternatives have technical merit. Comparatively, the preferred options from a technical perspective, are:

- Idaho, Montana, Wyoming, and a Mix of these Northern Rocky Mountain (NRM) states are recommended as the preferred donor populations, as logistical, source site jurisdiction, and other considerations allow. Planning for all three states and keeping options open and flexible is also recommended both for the initial donor population and for subsequent donor populations as needed. Some TWG members recommend Wyoming as slightly preferred.
- Washington and Oregon are next in preference.
- Great Lakes are third in preference: wolves from this region should only be further considered if other options above are not available.
- Use of gray wolves from the above states would be consistent with state law in Colorado, which states that *Canis lupus* must be reintroduced to the state.
 - State law does not specify the source of the wolves, nor does it describe the differences among subspecies. With the exception of Mexican wolves, all other wolves in the western US are managed as a single entity, and use of gray wolves from ID, MT, WY, WA, OR, and the Great Lakes would be appropriate for reintroduction to Colorado as well as consistent with state law.
 - Wolves that have naturally colonized and were reintroduced to the NRM states are different subspecies than were mapped to have previously existed there, though delineating precise lines of where one subspecies' distribution ended and the other's began is not possible. The animals reintroduced are of comparable size and weight as to what was historically in the NRM and in Colorado.
- Mexican Wolves (*C. l. baileyi*) are lowest in preference; Mexican wolves should only be further considered if other options above are not available as substantial process hurdles are presented with the consideration of this uniquely listed entity under the Endangered Species Act. Colorado is not historical range for this unique subspecies. The existing 10(j) for Mexican wolves could not be expanded into Colorado, as habitat has not been demonstrated to be irreparably damaged within the historical range of the subspecies. Utilizing Mexican wolves in Colorado would essentially be placing a Federally Endangered Species in the state, with no recovery goals/commitments for the state but with a long horizon as the species is eventually recovered within Arizona, New Mexico, and Mexico. It would not be possible to extend the management flexibility afforded by the 10(j) designation within the Mexican Wolf Experimental Population Area which would lead to extremely challenging management scenarios.
- All decisions are subject to future conversations and decisions with potential donor states.

Rationale/discussion:

Wyoming

- Wyoming has an aerial capture system that is somewhat predictable to time. This could facilitate the scheduling of successful capture and increase the likelihood of catching wolves and thus a capture/shipment event could be planned to move wolves to CO.
- To meet statutory obligations and keep costs down, Wyoming may be a good state to begin sourcing. However, it is important to keep options of where to source from open as there is no

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guarantee wolves will be available or that they can be captured in the predator zone when reintroduction begins.

- At least one of the currently documented wolves in Colorado naturally migrated from Wyoming and is currently successful, which may support sourcing from Wyoming. On the other hand, sourcing from states other than Wyoming could provide genetic variability as a complement to the natural migrators. However, it was alternatively suggested that the genetics in Wyoming are similar to those in other NRM states and that genetic variability is not a concern should Wyoming be chosen as a source of wolves.
- Wyoming has a smaller population of wolves and a requirement to maintain a minimum number of wolves, whereas, by comparison, Idaho and Montana have higher populations and may be easier to source donor wolves from. Wyoming has fifteen to sixteen breeding pairs currently, enough to theoretically provide five to ten wolves per year: this currently includes some animals in the predator zone where wolves can be legally killed.
- If WY is chosen as a donor population, wolves will be much closer to home so the homing instinct may be greater and may raise the risk of return to the predator zone where they could be harvested, leading to public criticism.
- It is also recommended to keep options open for getting wolves elsewhere, if available, at later dates. Although genetics are a non-issue now, some new genetics would have benefit if wolves reintroduced from places other than WY are used and become breeders.

Idaho, Montana, Mix of Northern Rocky Mountain Region states (MT, ID, WY)

- Considerations in support of sourcing donor populations from Idaho, Montana, and Wyoming include: the high number of wolves in those states (MT and ID); the very recent legislation in place around the status and management goals for reducing numbers of wolves in those states (MT and ID); generally negative public attitudes toward wolf presence in those states; that taking wolves from states where hunting is allowed may provide wolves that come with a fear of humans (MT, ID, and WY); that the prey preference of wolves in those states is elk (MT, ID, and WY); and their genetic viability (MT, ID and WY).
- Matching to the extent possible the ecological conditions at the capture and release sites (primary prey, migratory/resident behavior of prey, likely denning habitat, etc.) is important. In that sense, wolves across much of WY, MT, ID, eastern OR, and eastern WA would very likely work for western Colorado, where the primary prey is likely to be migratory elk that generally move from intermountain valley or lower elevation winter ranges to high elevation summer ranges.
- A recent genetic analysis of wolves in the Northern Rockies found a genetically connected population, such that selection of source wolves on a genetic basis was not a significant issue. Genetic variation is unlikely to lead to different behaviors.
- Maintaining contingency plans for other potential donor populations is important in the case of lack of availability or other obstacles.
- Proximity to Colorado's border, which facilitates some transportation logistics, was also considered as a factor of donor selection.
- It was also suggested that positive public perceptions of Yellowstone wolf populations may make them/NRM wolves more favorable for use as a source population. However, the public interest in individual wolves specifically from Yellowstone National Park; tolerance of those

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wolves to humans; and policy processes make selection of donor populations from Yellowstone NP less desirable. Social acceptance may be low for removing and/or managing Yellowstone wolves outside of the park and thus sourcing wolves from the park is cautioned against.

Washington and Oregon

- Selection of donor populations from Washington and Oregon would be less favorable than selecting wolves from other NRM states, but the option still has technical merit. Although Washington and Oregon wolves are also NRM wolves, Idaho, Montana, and Wyoming donor populations may be in greater alignment with public preference, for political reasons, as compared to the Pacific Northwest donor populations.
- Both Washington and Oregon have programs to capture wolves in winter; however, winter conditions in November and December affect potential success; increased cost and longer transport times also make these states less preferable than other states discussed above.

Great Lakes

- Selection of donor populations from the Great Lakes region has technical merit but is of lesser preference as compared to the Northern Rockies and Pacific Northwest.
- Great Lakes wolf populations are a viable candidate with respect to taxonomy (as are all source locations under consideration as previously described); however, the dissimilarity of the ecological context between the Great Lakes states and Colorado makes this a less favorable option as a donor population. Although there is some historical and contemporary measure of genetic mixture between coyotes and Great Lakes wolf populations, this is not considered an exclusionary factor for Great Lakes as a donor population. Although use of Great Lakes wolves in the restoration effort in Colorado could have technical merit, wolves from this region should only be further considered if other options above are not available.

Mexican Wolves (Arizona/New Mexico)

- Mexican wolves (a subspecies of gray wolves, listed as a separate entity under the Endangered Species Act) is the least desirable of the considered options. The historical range of the Mexican wolf does not include Colorado. Because they are listed as a unique entity under the ESA, maintaining the genetic uniqueness of this subspecies is paramount. If Mexican wolves were present in Colorado, premature interbreeding with wolves from the north could compromise the Mexican wolf recovery effort. Management considerations to address this potential issue in the Mexican wolf geography of recovery (AZ, NM) will reside primarily with the USFWS Mexican Wolf recovery team. Should gray wolves from other source populations described above be used as donor populations to Colorado, coordination between the Mexican Wolf Recovery Program and CPW is recommended to plan for and address potential interbreeding.
- Although the TWG discussed that use of Mexican Wolves in the restoration effort in Colorado could have technical merit, it recommends that Mexican wolves could only be further considered if all other options above are not available.

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Breeding programs

- A member of the TWG discussed whether CPW should consider use of a repository of unique genes from a captive population of the McCleery lineage of Great Plains 'buffalo wolves' (*C. l. nubilus*) as part of the gray wolf restoration effort.
- It was suggested by this TWG member that inclusion of this breeding program as part of the restoration effort could potentially conserve and restore unique genes from the original wolf population inhabiting the general region, enhance the populations' gene pool, maximize genetic diversity, and restore genes that would not necessarily be available in any other donor populations of wolves that could be used for restoration in Colorado.
- Several other TWG members raised technical concerns about high levels of inbreeding of the McCleery lineage as well as limited amount of genetic material available for artificial insemination and the overall conservation benefit; therefore, it is very difficult to assume that introduction of these genes is a net positive to the effort.
- Use of these genes is not recommended in the early years of restoration if they are to be used at all. If using a cross-foster method where pups of this lineage are bred in captivity and then introduced to established wolf dens, or artificial insemination of wild wolves, this would occur in later years of the restoration effort.
- One TWG member suggested that adding this genetic material does not address a need or an issue of low genetic diversity, as there is no evidence for low genetic diversity for the source populations of wolves being considered. While not the case, if the source populations were documented to have low genetic diversity, then there might be a reason to seek other genes to solve this currently non-existent problem.

Capture methods at source

Alternatives considered: Net gunning; helicopter darting; traps; snares; discretion of source population management; public trappers; other options.

Summary of TWG feedback: All alternatives have technical merit. The most preferred options are use of a net gun, helicopter darting, and discretion of source population managers, in no particular order. Snares and traps present a variety of concerns related to success rates and injuries.

Rationale/discussion:

Net gunning and helicopter darting

- Biological and social considerations support preference for helicopter darting and net gunning as capture methods. These techniques offer the most precise, data-informed predictive planning options and temporal relevance for fall and winter reintroduction efforts in the Northern Rockies. Either darts or net guns could be used depending on the landscape; helicopter work will be more challenging in highly forested landscapes and thus darting may be the only option if a helicopter is used. A well-coordinated helicopter pilot and gunner is important when undertaking a helicopter darting or net gunning capture method.

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- Darting and helicopter capture also provide the best selective potential; however, even these methods are non-selective, particularly in forested areas. The agency may need to consider capturing more wolves than needed to be somewhat selective in taking the desired age, color, and sex ratios in addition to the most fit animals (see below). Use of immobilizing drugs also accompanies these options.
- The use of an advanced spotter plane is recommended to locate wolves, to determine if they are in a workable location, and - if in a workable location- to determine what direction is best to approach them from and to keep an eye on the pack as they scatter once captures are initiated with a helicopter. When wolves selected for transport are shuttled to a holding location, the spotter plane can be used to locate other wolves for the helicopter to pursue once the shuttle is complete.
- Weather conditions may also constrain capture efforts. For example, snow conditions in the Pacific Northwest create difficulty for helicopter capture until closer to February, although a December capture event could be possible. It is valuable to have local staff as scouts to gauge snow and weather conditions in local environments; the ability to predict snow conditions can also improve the speed and efficiency of capture.
- A capture team with ample experience and a history of successful wolf captures will be required for helicopter captures to be a viable option. Helicopter wolf captures are generally more difficult and time consuming than helicopter captures for big game, and experienced pilots and capture crews can be successful where less-experienced teams cannot.
- Wolf capture is generally not a profitable enterprise for helicopter charting companies, and there is likely to be competition with their ungulate capturing enterprises. This may lend to having an alternative method to capture wolves; overreliance on helicopters alone could slow down the process.
- “Judas Wolves” are wolves that are captured and released back into the source population with collars such that they can offer options to track and capture wolves for relocation in future years’ efforts.
- Even with assistance from methods such as “Judas Wolves” or experienced tracking teams, plan for multiple options with low, feasible goals of the number of wolves captured per trip. For example, planning three to four events to capture two to three wolves per trip could be a feasible pace of capture, which would support a medium pace of release. However, lack of familiarity with landscape and pack dynamics is a limiting factor in the pace of reintroduction.

Traps and snares

- Traps and snares have technical merit; however, multiple TWG members advocated against the use of snares and traps as a capture method. Seasonal considerations can complicate capture and release coordination times; foothold traps have limitations based on weather. Neck snares can lead to significant and often unseen injuries to wolves. In past reintroductions, some wolves badly injured by neck snares were rejected as potential donors while others needed veterinary treatment after being damaged by traps. If selected, use snares with stops to prevent strangulation.
- Negative public perception can accompany release of potentially damaged wolves; there may be a heightened fear that damaged wolves could not hunt naturally and would prey on livestock. While the use of trapping generally polls negatively with the public, it polls less negatively when

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the purpose of conducting trapping is to enhance wildlife populations rather than be employed as for the purpose of regulated take.

- If traps and snares are to be used, consider strict regulations around the type of device, including features such as coil strength, and the need to check traps within every 24 hours to prevent freezing if wolves are caught in the winter. Trapping can be very effective if experienced trappers are employed (e.g., agency or professional public).
- Captures involving trapping are most likely to occur the summer/fall prior to reintroduction to fit wolves in potential donor packs with collars to aid in leading capture crews to their pack mates come winter. (See Judas wolves, above)
- Although novel capture techniques and technologies may be useful, there are capture techniques that have been proven effective in the NRM over the past twenty-six or more years: there is not a need to change approaches at this time.

Public trappers

- Public trappers can work in tandem with net gunning and helicopter darting tools. Use of public trappers can provide potential additional economic benefit that may be viewed favorably by donor states; one TWG member recommended avoiding using government trappers to avoid perceptions of bias and to ensure leading edge approaches. This option requires cooperation between state agencies in the source area and public trappers. In Montana, for example, if Colorado can contract with trappers directly, so they could earn money for their effort (as they may have otherwise, such as if they sold the pelt from a harvested wolf), the request to a state's wildlife commission could be to allow the trappers to capture live wolves to support this effort. Public trappers could also be used to assist agency personnel in capturing and collaring wolves the summer prior to captures in areas that are likely to be accessible to winter capture operations (See Judas wolves, above). While some wolves may not survive to winter, those that do will enhance the ease of winter capture.

Discretion of source population management

- Consider source population management and policies in potential donor population states. Some TWG members expected Montana policies to be highly favorable to selection for donor sourcing; others noted policies around species management in Montana, Idaho, and Wyoming may constrain sourcing options. Immediate engagement with potential donor states' game and fish agencies is important to build relationships in anticipation of potential donor selection, with considerations of the current political landscape in these states.

Additional logistical considerations for capture

- Coordination, knowledge, and understanding of populations, policies, and local officials in the source states enhance efficiency of capture; outreach to potential states' officials should be conducted as soon as possible.
- Advance work and coordination would greatly help in achieving a successful reintroduction by the end of 2023. Coordination with local officials from donor states may allow for early collaring of "Judas Wolves", which could add efficiency in capture: this could be done as early as 2022. Montana has six experts which coordinate to collar about twenty wolves per year over the

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course of two to three months of summer trapping and a month of helicopter capture efforts in the winter. Similar capture and collaring efforts occur annually in Idaho and Wyoming.

- The National Park Service in the Northern Rockies states also have considerable infrastructure in place to assist capture, although, as mentioned above, there are also cautions against selecting wolves from Yellowstone National Park, given their notable public reputation.
- Capture methods selection is related to location of the source population and access to animals and holding and transport (including potential need for pens near the capture site) are also considerations.

Age ratios

Alternatives considered: Young of the year; yearlings (one year old); dispersing age (two years and older); mature animals; and a mix of young and mature animals.

Summary of TWG feedback: All alternatives except for young of the year have technical merit, with no preference among the remaining alternatives.

Rationale/discussion:

- There may be some value of mature over younger individuals, as long as a wolf is not senescent.
- Young and mature wolves have little difference in dispersal patterns or predation behaviors: these features are more dependent on the individual wolf than on the age of the wolf.
- Having sexually mature wolves would be sufficient; and selection for age in capture methods may be limited.
- Yearlings and breeding age animals are most likely to be the most encountered animals in capture events. These animals are likely to be successful in Colorado.

Color ratios

Alternatives considered: Gray; black; mix; does not matter.

Summary of TWG feedback: All alternatives have technical merit. Selection by color generally does not matter and in general the color mix is dependent on what wolves are captured ('you get what you get'); use of a mix of colors was preferred slightly over a single color.

Rationale/discussion:

- A heterozygous black wolf has been found to be slightly resistant to disease, as opposed to homozygous black or grey. This difference is very minor, but given that research, having more heterozygous black wolves could lend a survival advantage: yet this would not be possible to determine during capture.
- Black wolves also look more dissimilar to coyotes, are more visible, and thus may reduce illegal take resulting from wolves being mistaken for coyotes; on the other hand, if more easily identified, this could more easily facilitate illegal poaching.
- Gray wolves can have black pups and vice versa; some research in Yellowstone suggests gray and black wolves seek each other out when forming new packs more than wolves of the same color as it may provide some evolutionary benefit.

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Sex ratios

Alternatives considered: Female skewed; male skewed; or 50:50.

Summary of TWG feedback: All alternatives have technical merit; the preferred option is a 50:50 sex ratio mix; followed by preference for a female skewed initial population; and least preference for a male skewed initial population.

Rationale/discussion:

- A goal of a 50:50 mix can help to avoid unnecessary releasing when capturing donors, based on the probability of male/female capture.
- Female skewed sex ratios may improve denning success.
- Helicopter darting and net gunning may slightly enhance the ability for selectivity. However, this will be dependent on where donor wolves come from (more open vs. heavily timbered locations).
- Males disperse more whereas females have higher reproductive success and have higher success of joining existing packs; however, the latter is not relevant when there are no preexisting packs.
- Because wolves are monogamous, skewing the sex ratio is not likely to help with reproduction. In Oregon, multiple instances have been documented in which a new male comes into the pack and breeds with a breeding female and her 2-yr-old daughters. In this case, skewing the female ratio could increase reproduction: however, it is unclear that this would happen in a reintroduction scenario when there are not preexisting packs.
- In some cases, whatever wolf presents an opportunity should be captured regardless of what sex and age it might be because that may be the only opportunity for a capture. In many cases, the specifics are determined when wolves are in hand.

Genetic considerations

Alternatives considered: Related pack members; unrelated, dispersing age animals; mix of packs and unrelated individuals.

Summary of TWG feedback: All alternatives have technical merit, with highest preference for unrelated, dispersing age animals; followed by preference for a mix of packs and unrelated individuals; and least preference for selecting only related pack members.

Rationale/discussion:

- Sourcing and capture of whole packs would be more laborious, costly, and constrain sourcing. Under the conditions of a hard release, the pack is more likely to split than stay together, providing support to not intentionally pursue an entire pack.
- As more members of a pack are removed, the pack can become destabilized at the source location, potentially leading to unintended consequences at the source. It was noted that a similar outcome was observed when members of the depredating pack were relocated to

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minimize conflict. However, destabilization vs. resilience of the pack at the source site may be specific to the age class removed. The removal of breeding females is most likely to destabilize the source pack, followed by breeding males; juveniles through two year-olds that are removed from the pack appear to have less repercussions on the stability of the source pack.

- If a hard release is used, there is limited impact/benefit of selecting related vs. unrelated animals on the dispersal patterns of released animals.
- There are some concerns that reproductive potential will be low for genetically related animals in localized release locations. However, a recent study in the Northern Rockies and Pacific Northwest that is near conclusion found that while there is some genetic structuring around the edge of the distribution (as expected of any species' population), there is a lot of genetic diversity and mixing across the whole region. Wolves have evolved mechanisms to minimize the effects of inbreeding, so inbreeding is likely to be a non-issue even if related wolves are released close to one another in space and time.

Animal reputation

Alternatives considered: Not known to be a depredator; known depredator; wolves that have been around livestock without conflict; wolves that have not been present around livestock at all

Summary of TWG feedback: The alternatives “not known to be a depredator,” “wolves that have been around livestock without conflict,” and “wolves that have not been present around livestock at all” were all determined to have technical merit as factors for sourcing donors; “known depredator” has technical merit as a criterion for exclusion from sourcing. Sourcing donor populations not known to be depredators (whether present around livestock or not) was preferential to sourcing populations not exposed to livestock, if possible. However, it is important to consider that most wolves overlap areas with livestock, and there is not a way to know the degree of interaction they have had with humans. No wolf should be translocated that has a known history of chronic depredation, and sourcing from geographic areas with chronic depredation events should not occur.

Rationale/discussion:

- There is nuance in determining depredation habits, with consideration of trends in the behavior of an individual and a pack. If a wolf is depredating livestock, the pack it belongs to is likely to depredate as well; additionally, if a pack is depredating, it is difficult to exclude one individual as non-depredating (see the Beartrap Pack's records of bison depredation). A known wolf or pack of wolves that have been identified as chronic depredators by the source location should not be used for translocation to Colorado.
- If a pack has had infrequent depredation events, as opposed to a chronic and well-known tendency to depredate, this should not, from a technical perspective, necessarily exclude consideration of a wolf or pack as a potential donor. However, from a social perspective, striving to use wolves with no known history of depredation is recommended. The history of a wolf's exposure to livestock populations is a consideration for potential for depredation. Sourcing from a pack that has not been exposed to livestock or a significant livestock grazing presence could be preferable: such packs exist in the central or northern Idaho wilderness, areas which have low grazing presence and scarce livestock, respectively. However, it might be more limiting than

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beneficial to constrain potential source populations to areas that are not suitable for livestock. Sourcing from populations which have been exposed to livestock, such as many populations in Montana and Idaho, but do not have a history of depredation, could also be preferable.

- Because depredation is situational, even wolves that are not known to be depredators have the potential for depredation. Situational factors could include public lands grazing and the vulnerability of livestock. Overall, it is difficult to predict depredation behavior.
- A study of wolf-livestock depredation in Montana found that depredation tends to recur in the same places, and the majority of livestock depredations are concentrated in those places. Places with recurrent livestock depredations tend to be places with higher livestock density, higher wolf density, and with intermediate proportions of public land (e.g., about half public land juxtaposed right next to private land that is about half of the area as well). There is at least a possibility that depredations are characteristics of the landscape rather than the wolves that are there (i.e., any wolf that lives there may eventually become involved in livestock depredations). While these areas can be avoided as sources for donor populations, depredation as a function of landscape characteristics suggests that it may be less likely to identify wolf packs that are more or less likely to depredate. Areas known to have chronic depredation should be avoided as a source of donor populations.

Disease issues at source sites

Alternatives considered: Prioritize areas for wolf capture as being those without disease.

Summary of TWG feedback: The alternative “sourcing from areas without disease issues” was determined not to have technical merit.

Rationale/discussion:

- Sourcing populations from areas without disease issues is not technically feasible. All wolves have some pathogens and parasites, such as endo- and ectoparasites, Echinococcus, or canine distemper/parvovirus: this is consistent throughout all populations. A determination of which diseases are parameters for exclusion should consider the diseases that already exist in Colorado; for example, any disease coming out of Montana is likely to already be present in Colorado. Overly broad criteria for exclusion due to pathogens or parasites will significantly limit potential source populations. Be deliberate in selecting populations without known issues and manage public reactions to sourcing diseased wolves via treatment during transport and through education on disease in the wild.

What to do with injured animals at source site

Alternatives considered: Release at source site; treat and release at source site; treat and release in Colorado; consider euthanasia.

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Summary of TWG feedback: All alternatives have technical merit. Utilize capture methods to minimize injury and avoid major injuries altogether. No alternative was most preferred; however, “treat and release at source site” was least preferred.

Rationale/discussion:

- In general, it is critical to select the most appropriate capture method, have standard protocols around capture and treatment (e.g., reference manuals from Yellowstone), and follow veterinary advice for appropriate treatment. This will also help assuage public concern or fear regarding injured wolves.
- The alternative selected depends on the severity of the injury. Injury will likely occur during capture; capture method largely determines frequency and severity of injuries (*see above*). Treatment for the minor injuries incurred during darting and net gunning is feasible and easy. Also consider the importance of maintaining capture and treatment methods that would not competitively disadvantage source individuals, and potentially make source populations more likely to prey on livestock.
- Minor injuries are injuries that could be addressed in a single treatment and do not require extended care. Provided there are no significant concerns, plan to translocate animals with minor injuries. Consider a more extensive rubric of conditions that might prevent translocation (e.g., multiple missing digits, multiple missing canine teeth, advanced age/unhealthy, etc.).
- Major injuries should be assessed and treated under veterinary guidance; do not translocate animals with major injuries. Major injuries would be those that would require repeated treatment, extended holding, or cannot be treated and require euthanasia. Portable radiography may be beneficial to have available in making assessments of injuries.
- Alternatives to treatment, such as euthanasia, for injured wolves at the source site not deemed viable to be used as a donor individual should consider veterinary input and local ordinances and protocols from source states. Euthanizing drugs lead to bioaccumulation and should not be used unless the carcass is retrieved. In cases of euthanasia, remove heads to prevent skull collection.
- Long-term care options should also be considered.
- If an animal is not healthy enough to be released into Colorado, it is up to the source site managers to decide whether it is healthy enough to be released back into the source population. Make sure that wildlife veterinarians from the donor jurisdiction and CPW are involved in capture plans and part of the capture team, so they can make real-time decisions about injury treatment and euthanasia. Defer to CPW and source site veterinarians as appropriate.

Transportation method from source to Colorado

Alternatives considered: Air; ground; mix.

Summary of TWG feedback: All alternatives have technical merit, with no group preference among the alternatives; each has situational relevance according to the plan of capture and translocation. Key to success is that capture, transport, and release should occur as quickly as possible to minimize time in captivity and stress on the animals.

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Rationale/discussion:

- There is a trade-off between the cost and time of each alternative and options are situationally dependent on the location (e.g., need for over-snow vehicles).
- Volunteer aircraft may help to reduce costs.
- Keeping options open enhances the latitude and flexibility of decision making in the translocation process, especially in the case of inclement weather and unexpected conditions.
- For air transport, consider holding pens near the capture location, transport to the airport in trucks via large crates, use of a cargo-type aircraft that can hold multiple crates for quick transport to Colorado, and transport from airport to release location via vehicle, helicopter or any other transport method.
- Consider the most appropriate handling crates for holding and transport, including consideration that crates provide protection such that wolves cannot chew them. TWG members can provide further details, experiences, and design recommendations from past reintroductions.

Animal handling considerations

What to feed during a period of captivity

Alternatives considered: Roadkill; carnivore logs; minimizing captivity time and feeding needs; ice/snow/free water.

Summary of TWG feedback: All alternatives have technical merits, with various practicalities to consider. Regarding food source, minimizing captivity time and feeding needs is preferable, followed by carnivore logs (typically, conditioned horsemeat) and roadkill. Ice/snow/free water are all recommended.

Rationale/discussion:

- Slight preference for carnivore logs over roadkill is due to the additional logistic details to consider with sourcing roadkill, such as availability, concerns that roadkill could have been poisoned, and prions and other diseases that exist in roadkill, all of which would need to be coordinated with the Colorado (and source state) wildlife health program. Carnivore logs would help guarantee the standards of having available food at a rate of ten pounds per animal per day of captivity.
- Stress in a condition of captivity prevents some wolves from feeding. Feeding approach depends on release method: The goal of a hard-release translocation should be to reduce the amount of time in captivity, and thus reduce the feeding needs. There are no data to suggest that a well-fed, hard released reintroduced animal would have more of a proclivity to stay close to their release site than a hard released animal that was held in captivity for a minimal time and not fed. Roadkill elk and deer would be preferred in holding pens at release sites if soft release is the preferred method, but if capture and transport occurs rather quickly, food is not likely to be needed.

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- Technical feedback on topics regarding social perceptions:
 - Providing food may be important for some stakeholders from a public perception standpoint. While feeding may not be biologically important during capture and transport, this may depend on the length of holding and transport. It is still recommended to make food available should it be needed, should delays or other contingencies arise.
 - There could be a social concern that use of carnivore logs would lead to a public perception of training reintroduced wolves to eat cattle. The technical reality is that carnivore logs will not create depredation tendencies. Wolves do not learn to prey on livestock by eating dead livestock; feeding of carnivore logs does not precondition for or against livestock predation.

Where and how to hold animals prior to shipping and upon initial arrival in Colorado

Alternatives considered: Bare bones holding facility to be used for as short a time as possible.

Summary of TWG feedback: Bare bones facility for as short a time as possible is preferred.

Rationale/discussion:

- This topic refers specifically to where and how animals are held, as needed, in their state of capture as well as upon immediate arrival in Colorado. This topic does not refer to whether wolves are hard released or moved to a soft release site after initial arrival (see 'Reintroduction Technique,' below).
- Minimize the period of captivity in a hard-release condition. Past experiences included public scrutiny of the period of captivity; however, gray wolves are resilient and durable.
- Flexibility is key when approaching this issue.
- As noted in capture considerations, holding pens near capture may be needed, in part because not all animals may be captured on the same day.
- Preparations and contingency plans should also be made for holding pens, as needed due to weather or other reasons, in Colorado.

Immobilization drugs to be used

Alternatives considered: Telazol, tranquilizer use during transport

TWG feedback: Telazol is preferred as an immobilization drug for capture; tranquilizer use during transport has technical merit but is not preferred and should be avoided. Travel and holding time should be minimized and use of tranquilizers and immobilization drugs during transport should be minimized as much as possible.

Rationale/discussion:

- Telazol is a standard immobilization drug used in previous processes and is the safest given its streamlined application.

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- Tranquilizers for muscle relaxation (not sedation) should be avoided: if needed they should be used under the direction of a veterinarian. Use of multiple drug regimens have previously resulted in seizures and post-release mortalities, and there was advocacy to simplify the drugs used.
- Wolves can be successfully held in a shipping container without tranquilizers from twenty-four to thirty-six hours from capture to release; simplicity is key.
- Defer to CPW and other veterinarians as appropriate. Maintain flexibility to tailor drug protocols to the specific situation.
- As discussed above, consider the most appropriate handling crates for holding and transport, including consideration that crates provide protection such that wolves that are not tranquilized or immobilized cannot chew their crates.

Collars/marks on animals initially reintroduced into the state

Alternatives considered: VHF; GPS; mix of VHF/GPS; no collar; PIT tags; ear tags (perhaps temporarily when in captivity)

Summary of TWG feedback: All alternatives have technical merit, *except* the alternative “no collar” for animals initially reintroduced into the state. It is preferred that every released wolf has a GPS collar, with variability in durability of GPS collar types as an important consideration. Ear tags are less preferred as compared to the other collaring/marketing alternatives.

Rationale/discussion:

- There is value in collaring every wolf reintroduced for monitoring and data collection purposes and to learn from and improve upon for future releases; however, it is important to educate the public and set expectations that not every wolf in Colorado will be collared as the population grows. It is also important to understand that collars tell us where wolves have been but not where they are present. Collaring can also help to catch poachers.
- For any collar used, ensure that the frequency used accounts for the potential for interference due to environment/terrain or other collared wildlife and/or domestic dogs that share the same frequency. Coordination with other states on frequencies will also help for tracking dispersers into other states. Use of similar frequencies as neighboring states for wolf collaring is recommended.
- Satellite-linked GPS collars can provide the best remote data but are more breakable/less durable than VHF collars. There are tradeoffs in which GPS collars are selected based on durability vs. frequency of monitoring; survey collars are more durable, but research-type collars will provide more data points. Experiences in other states suggest that some brands may be more reliable, albeit more expensive.
- VHF radio telemetry is more durable. However, any radio collar can have problems at any point in time, and VHF frequencies -- as with other collars -- can be problematic, especially for dispersers; given how much wolves move and how hard the signals can be to find (especially in mountainous environments), some VHF collared wolves may be lost.
- VHF also forces biologists to be in the field and helps increase understanding of how wolves interact with the landscape. This is seen as beneficial. When comparing the two, there is value in the authenticity of monitoring and reporting to the public through use of VHF and the auxiliary

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data collected while in the field, in comparison to the remote data collection via GPS collar. However, costs of in field monitoring using VHF may not justify the cost compared to GPS. Be certain that proper FCC licensing has been completed.

- Consider use of GPS to start followed by later use of VHF as wolves begin to form packs; a combination of VHF and GPS could also be considered upon release: however, this is less preferred. When sourcing radios, use stout collars to mitigate damage from chewing.
- Colored collars could discourage illegal harvest by distinguishing wolves from coyotes: however, it could alternatively enable illegal harvest by making wolves more recognizable. Colored collars can be helpful in the event of a report or a photo of a wolf with a failed collar.
- Pit tags are preferred over ear tags due to robustness of monitoring and ear infections. However, DNA studies on captive wolves may obviate use of pit tags, and it may be somewhat expensive to pit tag every wolf. This should not be a requirement but can be employed when feasible. There are no perfect marking identifiers, with tradeoffs to each; selection of tool will be dependent on the goals and objectives of the monitoring program.
- There is no justification for not placing a collar on an animal that is handled for the reintroduction. All animals released should have a collar. Too much money and resources will have been invested in each translocated animal and monitoring the success of reintroduced animals is fundamental to the program.
- Recommendations regarding use of collars for monitoring after initial release will be discussed separately by the TWG in the future.

Samples collected from animals

Alternatives considered: Blood (red and purple tops); tissue; hair; photographs; fecal, other

Summary of TWG feedback: All alternatives have technical merit.

Rationale/discussion:

- Hair is not the best available sampling technique for genetics, especially for long term storage. Consider a simple cheek swab, whether ear tags are used; an ear punch can be collected as well (using a baby cryovial with desiccant).
- Weight, size, and basic physiological characteristics should be collected: these statistics help to address public questions and misconceptions on reintroduced wolves.
- Preexisting anomalies on wolves should be documented to record that the capture team did not negatively impact the wolf.
- Ectoparasites (if present) should also be collected.
- Whisker samples could be taken for stable isotope diet analysis.
- Consider collecting a minimum of 2 sample types from each animal in hand (2 genetic samples, 2 red top blood tubes, 2 EDTA blood tubes, multiple fecal samples, etc.) More would enable banking them in different locations.

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Veterinarian care in captivity

Alternatives considered: Defer to handling protocols

Summary of TWG feedback: As also discussed above, it is important to have standard protocols and for experienced veterinarians to be involved when wolves are in captivity to assist with: animal health monitoring, emergency care if necessary, sample collection, administration of vaccinations, etc. Biologists that have experience handling wolves and/or other wildlife will also be on hand to fit wolves with collar, ear tags, and/or PIT tags, and conduct basic monitoring, etc.

Disease testing and vaccine treatment

Alternatives considered: Test and treat everything possible

Summary of TWG feedback: Donor populations will have diseases and naturally migrating wolves will bring them. For captured wolves, the general recommendation is to test and treat everything possible, as this will help establish healthy populations; this will also help to foster social acceptance of reintroduction protocols.

Rationale/discussion:

- See above discussion of disease.
- *Echinococcus granulosus* (tapeworm) has been of concern at times for stakeholders in Montana.
- Some treatments may require multiple treatments for efficacy.
- Defer to veterinary expertise when devising disease treatment plans.

Reintroduction considerations

Reintroduction technique

Alternatives considered: Hard release, soft release, combination

Summary of TWG feedback: All alternatives have technical merit, with hard release preferred to soft release and to a combination of soft and hard release. There are pros and cons to consider for both techniques; however, hard release has greater technical merit as well as greater logistical and economic feasibility and is thus recommended by the TWG as the preferred technique.

Rationale/discussion:

- The key distinction between soft and hard release is related to acclimation. A hard release would entail capturing wolves and immediately translocating and releasing them to a site in Colorado, whereas a soft release would entail a period of conditioning wolves to their surroundings in Colorado before they were released into the wild.

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- In experiences with soft releases in Yellowstone National Park (YNP) and hard releases in central Idaho, both techniques worked. However, the hard release in Idaho was more successful in terms of both survival and population growth. Thus, the perspective of technical outcomes, hard release is preferred, and the logistical feasibility and associated economic burden of a soft release should deprioritize consideration of this technique for Colorado.
- Hard releases are quicker and cheaper, but their use may also lengthen the time for individual wolves to locate one another and pair up to produce offspring. Wolves may be more likely to travel further from the release location.
- In a hard release, there is some experience in transporting anesthetized wolves to a temporary pen; however, biologists did not observe much difference in the outcome than in a normal hard release.
- A soft release may be more likely to limit dispersal, with packs more likely to stay together and may be less likely to disperse and interact with livestock, decreasing conflict potential in the short term. However, while documented in the NRM releases, these benefits should not be overstated because wolves that are soft-released will still have post-release movement, as exhibited within the first five years following the soft release in Yellowstone. There is also variability of movement among individual wolves.
- A soft release could be considered should specific areas be identified that are highly suitable for wolves where there is a desire to keep wolves localized closer to the release areas. A soft release strategy should also consider suitable habitat for where wolves will overwinter; pens may need to be located at or near overwinter habitat. Soft release could be considered particularly if there is concern that a lack of distribution of suitable habitat would limit the success of and/or increase conflict with wolves that disperse following a hard release. However, social-ecological suitability mapping data does not provide clarity that there is such a preferred soft release acclimation site for Colorado.
 - TWG members further noted that, while not a technical issue, using soft release to attempt to address social concerns about post-release movement could create other social concerns if specific communities are perceived as being targeted for having wolves in their areas.
- A mating pair may remain together in a soft release strategy to raise a litter after being released, even if auxiliary members split. The soft release strategy with a related pack may build social structure, foster greater reproductive potential, and attenuate dispersal, but at a significantly greater financial and logistic cost. In the Yellowstone soft release, penned animals were unrelated and matched via sex and age. Wolves are likely to disperse regardless of pack dynamics; individual reputation would be a greater factor in conflict.
- The soft release in YNP included significant resources, including building structures, patrolling and staffing pens 24/7 while wolves were in the pens (for 10 weeks), and feeding wolves. Existing infrastructure at Yellowstone enabled the construction and tending of pens, which was not the case during the reintroduction effort in central Idaho.
- There are questions regarding the feasibility of a soft release in Colorado, including whether Colorado has the resources and manpower at its disposal to execute a soft release. The release technique may largely be determined by logistics considerations (including whether there are suitable sites for soft release) and funding.

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- Soft release in YNP also resulted in behaviors by wolves reflective of frustration with captivity. Quick capture, moving, and release is preferred.
- There is not a correlation between the method of capture and the method of release. Also, experience in trapping wolves to relocate them away from livestock indicates that capture practice had little to no effect on their dispersal patterns.

Time of year

Alternatives considered: Winter; spring; summer; fall

Summary of TWG feedback: Of the alternatives considered, spring and summer do not have technical merit; winter and fall both have technical merit; and winter is preferred over fall.

Rationale/discussion:

- Summer and spring do not have merit because of the undue heat stress the seasons place on reintroduced individuals.
- Fall presents risks of hunting season in the context of the vulnerabilities of recently reintroduced wolves.
- Winter (November through March) is preferred due to colder temperatures; snow cover to enable tracking; proximity to the first breeding season; proximity to annual peak ungulate prey vulnerability; and greater ease of protecting livestock during winter.

Considerations for where wolves could be released

Alternatives considered: Land ownership; livestock presence; geographic context; prey base; likelihood of supporting multiple packs; proximity to state border; vote results; seasonal elk supply.

Summary of TWG feedback: All alternatives have technical merit; vote results have least preference as a technical alternative to guide reintroduction location, but it is recognized that socio-political considerations will also be at play in selection of release area(s).

Rationale/discussion:

- A release area is any contiguous space where it is suitable for wolves to be released, whether via a single discrete release site or at multiple discrete release sites within the area. A release site can be used multiple times. A site where a wolf is released is not expected to be necessarily where the wolf will stay. See further discussion below.
- The highest quality habitat is generally large, contiguous areas of public lands with a high abundance of prey and low livestock densities. Consider where most big game are located during the time when releases occur and where livestock are or will be in relation to big game during other seasons. Regardless of where wolves are released, habitat selection may differ greatly compared to habitat models.
- Release sites do not necessarily have to be federal lands. Consideration of overall landscape context should inform the selection of release areas/sites.

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- Dispersal and homing tendencies of reintroduced wolves may or may not affect donor population selection. The proximity of Wyoming to Colorado may lead to a higher potential of wolves returning across state lines after being reintroduced. Dispersal studies reflect an average dispersal from the release site being sixty to seventy miles but could vary significantly by individual. Some TWG members suggested there is a northerly homing tendency; others suggested wolves disperse in a starburst pattern, with no particular cardinal orientation.
- Post-release dispersal is not comparable to natural dispersal; the average duration of dispersal is five and a half months after release. Seasonal dispersal and seasonal migration patterns of prey species such as wild ungulates will also affect dispersal of wolves.
- It is important to consider the proximity of the release area to a state border. Release at least seventy-five miles from a state border should be considered. This buffer should also be considered for the borders of sovereign Tribal nations in Colorado, in consultation with these Tribes; so that wolves do not immediately disperse to neighboring states/Tribal lands.
- Especially under the conditions of a hard release, not much attention needs to be paid to territoriality. Consider release sites that can support several packs to create a small population that supports reproduction and the sustainability of the reintroduced wolf population. Avoid creating widely dispersed, isolated packs to improve connectivity. Clusters of packs will help to avoid poor survival and recolonization trends.
- Interactions with human populations should be considered, and large populated areas should be criteria for exclusion of release sites and areas. A flexible pace outlined below can also help to address issues as they arise.
- Wolves can succeed anywhere with adequate habitat where there is social acceptance; consider findings from an in press (as of 8/2021) landscape analysis to inform the social and human considerations for release sites and areas. Due to dispersal, where wolves settle may be far away from the release location; consider social and topographic factors where wolves might pass through during dispersal when selecting release sites and areas.

Number of release sites (and number of release areas)

Alternatives considered: Flexibility in specific release sites for an area with multiple release points; multiple release areas; and one release area

Summary of TWG feedback: All alternatives were determined to have technical merit. The alternative to have flexibility in specific release sites for an area with multiple release points is most preferred.

Rationale/discussion:

- Consider the number of release areas *vis a vis* the number of wolves reintroduced. It is likely that not many release areas will be needed in Colorado to ensure wolf population growth. Flexibility between a few (e.g., one to four) release areas would be prudent, with the option to return to the same area or areas to release wolves over the course of several years. Adaptive management will allow refinement of reintroduction logistics and technique year-by-year.
- A minimal number of release sites, such as a one or two logging roads, could serve to meet the goals of reintroduction in a short period of time with minimal logistical complications.

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- Use of a higher number of areas and release of wolves in largely geographic dissimilar and dispersed locations complicates the likelihood that wolves will encounter one another and begin breeding. It is therefore not desirable to have too many geographically diverse release areas.
 - If wolf population growth proceeds in Colorado like it did in the NRM following those reintroductions, most of Colorado would be occupied by wolves within about ten years. Reducing the social or geographic burden on specific release sites by distributing these areas is only a consideration for a few years before wolves spread out on their own.
 - If the wolf population in Colorado does not grow following the translocation as fast as occurred in the NRM, there would be an opportunity to establish additional release areas or sites as appropriate to meet recovery goals.
- Alternatively, all wolves could be released in one area, at multiple sites to provide for security and flexibility.
- Lessons from other states include:
 - When combined with natural recolonization into northwestern Montana (as is currently occurring in northwestern Colorado) beginning in the 1980s, two release areas were used in the northern Rockies in the mid-1990s. Within ten years of those releases, much of the suitable habitat in Idaho, Montana, and Wyoming was occupied, and within twenty years wolf populations had become established in Washington, Oregon, and California, all based on these two release areas.
 - To better understand the terminology used, Yellowstone National Park is a large release area with multiple (six) release sites.
 - The human population density of Colorado should play a role in informing the number of release areas and sites.

Pace of wolf reintroduction

Alternatives considered: About thirty to forty- wolves reintroduced for one year (Fast); about ten to fifteen wolves reintroduced per year for two to three years (Medium); about five to ten wolves reintroduced per year for three to six years (Slow), be flexible (*Note:* numbers are not concrete, and are meant to suggest relative pace)

Summary of TWG feedback: All alternatives were determined to have technical merit. The overall goal is ultimately to establish a self-sustaining population. The goal of the initial translocation and restoration is to introduce enough wolves at an adequate pace to establish a growing population that can ultimately achieve a self-sustaining population. Without specifying what that might look like from a numerical perspective and/or other indicators, there are a variety of ways (i.e., paces) that could work to achieve a growing population. The general technical preference is for a “medium” pace, followed by a “slow” pace, and, least favorably, a “fast” pace. It is important to be flexible and adapt the specific logistics of these paces according to conditions of the reintroduction. It is also important to be adaptive around specific dates and numbers. *Note:* Discussion of this topic focused specifically on the number of wolves actively reintroduced, not long-term population goals or management thresholds. The latter will be addressed at a future meeting(s).

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Rationale/discussion:

- A medium pace is an appropriate balance between the need to reach critical mass and a maintain a feasible pace to reach critical mass. It is important to employ adaptive management strategies and robust monitoring to maintain the flexibility of reintroduction efforts, to be nimble to adapt to the constraints around capture, and to monitor the success of release. Public support may also be garnered by approaching reintroductions with a moderate and flexible pace.
- Rationale against a slow pace of reintroduction is that the population may not reach critical mass to achieve a growing population under this pace. The vulnerability of recently reintroduced wolves to illegal human-caused mortality may be an additional impediment to reaching critical mass. Colorado has smaller tracts of public land compared to Yellowstone and the NRM region, which may enhance susceptibility to illegal mortality. A slow pace has a higher likelihood of program failure than does a medium pace.
- A fast pace may not be logistically feasible (see capture considerations above) and the complicated logistics associated with a fast pace may also lead the program to a premature failure.
- Much of the discussion around pacing revisited topics of capture methods (see above) as well as considerations for release areas and sites. Coordination of capture efforts with release sites is important; the pace of release may be constrained by efficiency of capture.

When to stop and/or pause reintroduction

Alternatives considered: After about forty animals have been moved; indication of pack establishment; indication of pack establishment with some documented reproduction; two packs raising two pups for two consecutive years; flexible approach: i.e., do releases (e.g., of thirty to forty wolves) and then pause to see what happens

Summary of TWG feedback: All alternatives have technical merit. The preferred option is to do ‘a bunch’ (undetermined number) of releases (e.g., release a total of approximately thirty to forty wolves), then pause, assess, and adapt based on whether the initial restoration phase has resulted in an adequately growing population that will ultimately achieve a self-sustaining population. *Note:* This discussion is focused specifically on when to pause active reintroduction, not on long-term population goals, definitions for self-sustaining populations and long-term success, or management thresholds. These latter topics will be addressed at a future meeting(s).

Rationale/discussion:

- Adaptive management is important: generally, it is recommended to release some number for two to three years, pause, and then monitor and model population growth to determine trajectory toward a self-sustaining population, and adaptively manage based on that model.
- The parameter of ‘when to stop reintroduction’ is not the same as the definition of a ‘self-sustaining population,’ but is rather a benchmark toward achieving that goal.
- It is important to predict and monitor a rate of growth and conduct analysis between rate of growth and the overall status of the population.

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- Experiences in other states can inform the approach; however, adaptive management and flexibility to learn and respond to what happens in Colorado is key.
- TWG members have a variety of perspectives on topics related to ‘when to stop reintroduction.’ In addition to the general feedback of the group (above), additional *individual perspectives are provided below*:
 - There was discussion around the definition of a pack; some define it as at least a pair of wolves; others define it as a pair of reproducing wolves with a litter. In the Northern Rockies, a breeding pair was defined in the recovery plan as a pair that recruited at least two pups through the end of the year.
 - There is no reason to pause before thirty to forty wolves are released over the course of twelve to eighteen months: data are adequate to support the pause with a more minimal approach.
 - Recognize that a pause in reintroduction might lead to a stop, given a monitoring program to track population growth after two to three years.
 - A pause should occur when the reintroduction target of approximately thirty to forty wolves (released at a ‘medium pace’ of approximately two to three years as described above) is achieved to assess whether the population is growing at an adequate rate toward a self-sustaining population and if wolf-livestock conflicts can be managed successfully in the areas where wolves become established. In general, some ambiguity is needed to allow for the flexibility required by adaptive management; objectives should not be overly restrictive to prevent adaptation to experiences and/or conflicts during the reintroduction phase. Arbitrary numbers for defining the number of wolves to be reintroduced or when to pause reintroduction should be avoided as they could be limiting or create problems for adaptive management later.
 - Each reintroduction effort’s population growth is different; it is possible that the Northern Rockies is the best model to follow to determine models for Colorado’s population growth. In Oregon, from a population of fourteen wolves, the population doubled every two years for the first five years. Mexican gray wolves were released from captive stock and repopulation dynamics were considerably different than in the Northern Rockies and are still releasing twenty years after initial reintroduction.

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Appendix A: Technical Working Group members

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Alan Bittner	Bureau of Land Management, Deputy State Director
Stewart Breck	National Wildlife Research Center U.S. Department of Agriculture, Research Wildlife Biologist
Roblyn Brown	Oregon Department of Fish and Wildlife, Wolf Program Coordinator
Wayne East	Colorado Department of Agriculture, Agricultural/Wildlife Liaison
Justin Gude	Montana Fish Wildlife and Parks, Research and Technical Services Bureau Chief
Jonathan Houck	Gunnison County Commissioner
Mike Jimenez	U.S. Fish and Wildlife Service, Retired
Merrit Linke	Grand County Commissioner
Steve Lohr	U.S. Forest Service, Rocky Mountain Region Renewable Resources Director
Carter Niemeyer	U.S. Fish and Wildlife Service, Retired
Martin Lowney	U.S. Department of Agriculture Animal and Plant Health Inspection Service, Wildlife Services, State Director
Eric Odell	Colorado Parks and Wildlife, Species Conservation Program Manager
Mike Phillips	Rocky Mountain Wolf Project, Founder/Turner Endangered Species Fund, Executive Director
John Sanderson	Colorado State University Center for Collaborative Conservation, Director
Doug Smith	National Park Service, Yellowstone National Park, Senior Wildlife Biologist
Robin Young	Colorado State University Extension Service, Archuleta County Extension, Director, Natural Resources and Agricultural Agent

Technical Working Group report developed with third party facilitation from Keystone Policy Center.

Appendix F: Final Report on Technical Considerations on Compensation for Wolf Damage to Livestock

Colorado Wolf Restoration and Management Plan Technical Working Group (TWG) to Colorado Parks and Wildlife (CPW)

Final Summary of Technical Considerations on Compensation for Wolf Damage to Livestock February 2022

Background & Purpose

The document summarizes the Wolf Restoration and Management Plan Technical Working Group (TWG) discussions regarding technical considerations of potential components of a livestock damage compensation plan. ‘Technical considerations’ in this context include perspectives on biological relevance, ability to quantify and/or measure, impact on technical outcomes, feasibility for managers, and experiences with and/or in implementing programs in other states. This document is intended to help provide background to inform discussions regarding a Colorado compensation plan for wolf damage to livestock.

This document is not a comprehensive set of recommendations on a complete compensation plan. The TWG recognizes that there are various social considerations for livestock compensation that the Stakeholder Advisory Group (SAG) has discussed, and that the SAG was charged with leading the development of comprehensive recommendations regarding the compensation plan.

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Eligible Damages

Confirmed depredation

Background: To confirm a depredation, CPW uses a "Preponderance of Evidence" standard; documentation by the claimant necessary to support a claim for damage can include "tangible evidence" such as photographs, scat, tracks, attack and feeding characteristics, puncture wound spacing, hemorrhaging, etc.

Summary of TWG feedback: Compensation for confirmed depredations at fair market value has technical merit.

Discussion and rationale

- TWG members emphasized the importance of timely and skilled investigation to confirm a depredation. They noted that the presence of scat and tracks alone are not technically sufficient to confirm a depredation. Because wolves are also scavengers, their presence at a carcass is not enough to confirm that they killed the livestock.
- TWG discussed that probable losses, missing livestock, and/or indirect costs associated with confirmed wolf depredations could provide technical merit for compensating more than 100% for the confirmed loss. Discussion of these topics, including discussion of multipliers and compensations ratios, is detailed below.

Probable depredation

Background: CPW currently does not have a definition for 'probable loss,' and rather uses a preponderance of evidence standard. Different states apply different definitions of 'probable' loss. An example definition for "probable" loss based on USDA APHIS/Wildlife Services includes the presence of some evidence to suggest possible predation but a lack of sufficient evidence to clearly confirm predation by a particular species. A kill may be classified as probable depending on factors including but not limited to recent confirmed predation by the suspected depredating species in the same or a nearby area, recent observation of the livestock by the owner or the owner's employees, and telemetry monitoring data, sightings, howling, or fresh tracks suggesting that the suspected depredating species may have been in the area when the depredation occurred.

Summary of TWG feedback: Compensation for probable depredation has technical merit. A range of compensation amounts (50-100% of fair market value) were suggested as having technical merit, however lesser amounts (i.e., less than 50%) were not suggested.

Discussion and rationale

- Criteria of probable depredation
 - Clear definition of probable depredation is important for managers in administration of the program and for producers in understanding the program.
 - U.S. Department of Agriculture Animal Plant Health Inspection Service – Wildlife Services (USDA APHIS-WS)'s definition of probable losses has been adapted by the states that have adopted probable depredation compensation models. Consultation with other states regarding their experience around probable losses is advised.

- In some states, the incidence of compensation for probable losses was initially high but has waned over time, due to the increased knowledge and experience of investigators over time. With this experience, there is likely to be a decrease in the number of incidents classified as probable losses, and thus a decrease in compensation paid for probable losses.
- It is important to define whether/what secondary management actions are triggered by a 'probable depredation' designation, as well as whether a 'probable depredation' can trigger a multiplier or compensation ratio (see below).
- Compensation amount
 - Compensation at 50-75% of fair market value were suggested to be economically feasible and adequate for probable depredation. Higher amounts (i.e., 100% of fair market value) were also seen by many as having technical merit as well as potential social merit in increasing social tolerance.
 - Different payment amounts for confirmed vs. probable depredations could complicate use of a multiplier if both kinds of losses trigger a multiplier (see below).
 - Compensation for probable losses at a different rate than confirmed losses may also complicate management of the compensation program and potentially could make the claims process more onerous for producers.

Compensation ratios/Multipliers

Background: The TWG considered the potential for use of a compensation ratio or multiplier to address missing livestock and/or indirect losses. The TWG considered use of a compensation ratio on public versus private lands, the value of the compensation ratio, and minimum acreage required, if any, to be eligible for compensation ratios.

Summary of TWG feedback: Compensation ratios for both cattle and sheep on public and private lands have technical merit, but there are different perspectives and technical considerations regarding when these ratios should be triggered and how they should be administered. TWG members generally were uncertain as to what an appropriate ratio should be. Technical considerations for and against minimum acreage requirements include consideration of total leased lands, use of penning versus open range grazing, and other factors.

Discussion and rationale

- There is significant complexity in considering how to fairly apply a multiplier or compensation ratios.
- Frequency of missing livestock occurs at different rates depending on the age and type of livestock, spatial and temporal factors and differences in producer practices, such as regularity of cattle checks and detection rates.
- Compensation ratios may be more likely to be used in situations where locating depredations is more challenging and for livestock that are more vulnerable to depredation (i.e., calves and all sheep). Patterns of depredations observed in other states could be useful to constrain criteria for compensation ratios to only include certain ages or types of livestock.
- Compensation ratios could be employed with spatial considerations. However, this would be complex to implement.
- Variation in detection rate between producers, uncertainty in cause of death (such as due to another predator), and lack of well-documented trends lends to the importance of management discretion if a multiplier is to be employed.

- The use and value of a compensation ratio could also consider other factors such as implementation of conflict reduction cost-share programs or pay for presence programs.
- Compensation ratios may incentivize regularity of cattle checks but may also disincentivize conflict risk reduction solutions and improved management practices, as well as impede management of wolves similarly to other predators in Colorado.
- Minimum acreage requirements may lend managers flexibility for best management decisions, but number of missing livestock may also be a better criteria. Minimum acreage requirements are complicated by land use and ownership issues, such as livestock producers leasing multiple small acreage parcels. Further, current game damage program criteria do not distinguish between various types of operations (e.g., producer vs. hobbyist); acreage requirements may be confusing and create arbitrary distinctions for eligibility that may be inequitable.
 - For example, minimum acreage requirements could refer to the total area within which a livestock herd experiencing depredations is grazing. The idea would be to offer a compensation ratio for livestock depredations that occur in herds that are grazing a vast area, such that documenting additional depredation events would be difficult even if additional individual livestock are missing. Conversely, compensation ratios might not be applied when depredations occur in smaller pastures in more controlled settings, where detecting depredations is easier.
 - Terrain and vegetation characteristics may also be considered when determining whether and how to apply a multiplier for large tracts of lands where missing livestock are more difficult to find.
- Range cattle producers by the nature of their operations and large scale of acres being grazed will have difficulty participating in any compensation program since they infrequently become aware of depredation events that allow timely submission of documents to CPW.
 - Multipliers typically require having verified losses; it is more difficult to verify losses for cattle than for sheep and thus it will be more difficult to apply a multiplier or compensation ratio to cattle.
 - Given this challenge, alternatives for compensating for missing cattle, other than multipliers, should be considered. Criteria such as animals put on grazing allotments, the difference in animals collected at end of the grazing season and known presence of wolves on the grazing allotment may be appropriate to consider for missing cattle.
 - Multipliers may not be appropriate for all calving on open range because of the difficulty of distinguishing whether calving was successful vs. whether calves were lost to depredation. However, not all producers have a choice as to whether or not they calve on open range.
- From a technical perspective, size of pasture or rangeland is important in impacting detection of confirmed, probable, and missing livestock.
- Land ownership (public vs. private) is a social consideration rather than a technical consideration for compensation.

Indirect losses (Also referred to as production losses by the SAG)

Background: Indirect losses are those associated with economic impacts other than death of livestock.

Types of indirect losses considered: Pregnancy rates, weaning rates, lower weight gain due to stress or increased activity rates, future economic losses (for example, loss of future production or loss of investments in genetics), other losses.

Summary of TWG feedback: The TWG noted the technical reality of indirect losses such as those considered above but also noted that many factors can contribute to indirect losses. There was mixed feedback on whether there is technical merit to compensate for indirect losses, particularly as there is not a clear or proven technical approach for quantifying and compensating for indirect losses.

Discussion and rationale

- Reduced summer weight gain and other indirect losses can be subject to external factors beyond wolf depredation – for example, spatial or interannual variability in weather and forage production, other predation, and effects of other land use pressures such as recreation on public lands. It can be difficult to separately determine or fairly compensate indirect loss due to effects of wolf-livestock interactions.
- There is a lack of a concrete scientific body of research on indirect losses and conflicting anecdotal information. Documentation of indirect losses varies between producers.
- Indirect losses could be compensated through a multiplier or compensation ratio. If allowing compensation for indirect losses separate from a multiplier, stringent documentation and confirmation criteria are important to prevent abuse. In one state that allows compensation for indirect losses, the process is cumbersome and complex for producers. Currently, there is not a consistent approach among states, nor technical consensus on an approach for quantifying and compensating for indirect losses apart from using multipliers for confirmed losses.
- Multipliers have served to reduce social conflict in some places.
- The TWG recognized that there are also social considerations regarding compensation of indirect losses. A member noted that there are social science studies that indicate that wolf restoration would be better received if indirect losses were acknowledged and accounted for.
- Availability, or lack of availability, of lethal management tools to reduce indirect losses is also a consideration for whether to compensate for indirect losses.

Pay for presence program

Background: Pay for presence programs provide compensation for presence of wolves on lands used for livestock production, regardless of whether there is confirmed, probable, or indirect loss.

Summary of TWG feedback: The TWG offered a variety of perspectives regarding feasibility, purpose, and efficacy of a pay for presence program, without clear consensus on whether or not such programs have technical merit.

Discussion and rationale

- Pay for presence programs can help to recognize and value the benefits of private landowners in providing wildlife habitat, migration corridors, carbon sequestration, watershed health, and recreational opportunities. Additionally, implementation of a pay for presence program may be a simpler way to address indirect losses and/or probable depredation.
- Pay for presence programs were implemented to minimize illegal killing of wolves to assist in and benefit species recovery, as it was employed to do in the Mexican gray wolf recovery effort in Arizona and New Mexico, but may not lend to conflict reduction.
- Potential drawbacks of a pay for presence program include inconsistency of treatment of wolves vs. other predators, funding constraints and monitoring requirements. Similarly, paying for wolf presence on private land may lead to paying for presence of other wildlife species, or at least

landowners questioning why this is not the case, which could lead to more expense and distribution monitoring needs for other species.

- Actual damage may not justify pay for presence, with spatial and landscape factors such as vulnerability of livestock and location of dens and range geography more greatly informing depredation patterns than presence of wolves.
- To properly distribute available funds, this program may also require a greater degree of monitoring, which may constrain agency flexibility to allocate time and staffing resources to the development and deployment of conflict risk reduction tools.
- Pay for presence would create an additional financial burden.
- Pay for presence may also disincentivize producers to adopt conflict minimization practices, while not reducing conflict between wolves and livestock.
- The funding constraints of compensation, in addition to the staffing and capacity constraints indicated above, may also prevent management flexibility and ability to compensate for confirmed, probable, or indirect losses.
- One consideration for initial restoration is to compensate producers through a pay for presence program near and around a certain radius of release sites. It would need to be determined whether such compensation would be for a certain amount of time following release, or indefinitely. It would be difficult to determine the appropriate radius or amount of time for which to do this, and could create administrative challenges as well as concerns over fairness for producers falling just outside of temporal or spatial boundaries to qualify for the program.

Administration and Funding

Damage investigations

Background: CPW conducts most game damage investigations in the state. Some verification is also conducted by USDA APHIS-WS.

Summary of TWG feedback: Conducting damage investigation via CPW and APHIS-WS has technical merit. Investigators should have adequate training to conduct professional, consistent damage investigations.

Discussion and rationale

- A central consideration for investigative authority is adequate training. Both CPW and APHIS-WS staff are well-trained and trusted in local communities to conduct damage investigations. Investigation training courses could be offered on a regular basis to ensure investigators stay up-to-date on investigation practices.
- Regardless of the compensation formulas used, key to a successful compensation program are unbiased field investigators providing honest and accurate assessments.
- While the TWG generally did not see technical merit in the use of other potential investigative bodies, they noted that there may be other social values in having local officials accompany professional investigators and livestock producers and/or landowners during damage investigations.
- It will be important to depoliticize damage investigations as much as practical. In some highly politicized or controversial investigations, USDA APHIS-WS could serve as a sort of “third-party neutral,” which would help to protect relationships between state officials and local

communities. However, different agencies may be viewed differently by various stakeholders. Consistency of approaches within the state is important to build trust between the agencies, and among agencies, livestock producers and the public.

- Communication of investigation standards to impacted parties should be a priority, and local individuals should be equipped with the appropriate knowledge and tools to navigate the claims process. A valuable purpose of public and stakeholder engagement is in increasing knowledge of how to 1) protect the scene of a potential depredation so an investigation may be conducted with minimal contamination and 2) follow the appropriate steps to successfully file a claim for compensation if a wolf, or other large predator, were determined to be the cause of the depredation.

Funding sources

Background: CPW's Game Damage Program is funded by the appropriation of sportspeople's dollars from the Wildlife Cash Fund. HB21-1243, passed during the 2021 Colorado legislative session, prohibited use of wildlife cash funds generated from the sale of hunting and fishing licenses or from associated federal grants to fund the program implementation and administration of the restoration and management of gray wolves.

Summary of TWG feedback: TWG perspectives generally support using multiple sources of funding for compensation and other livestock interactions issues, although there were varying perspectives on whether this is a technical issue and/or is an issue with technical merit. Consistency in administration of funds, regardless of sources, was emphasized.

Discussion and rationale

- Maintaining reliability and consistency of funding are common considerations. Donations and/or funding from external sources such as NGOs should be considered from these perspectives.
- While some suggested a decentralized funding paradigm could support localized management strategies, others strongly discouraged management priorities and administration of funding to be set by any agency other than CPW and the Parks and Wildlife Commission.
- In some other states, the Department of Agriculture is responsible for administration, however Colorado statutes are clear that this responsibility lies with CPW. Use of sources that are already allocated for other special interests, such as license plates or tax checkoffs, would potentially dilute already limited funding.
- Some encouraged maintaining the status quo regarding funding for other species; others suggested wolves may imbalance current financial frameworks.
- Difficulties in obtaining and maintaining federal funds were noted.

Administration

Background: CPW is currently the sole administrator of reimbursement for game damage.

Summary of TWG feedback: The importance of consistency of funding administration was common feedback. The pros and cons of using other agencies as administrators for funding and/or for other elements of the game damage program was also discussed.

Discussion and rationale

- Other states' funding administrators include state departments of agriculture and/or livestock, local government, and federal government.
- Political agendas, public and private special interests, and trust in administrators were recurring concerns regarding multiple administrators.
- Use of a sole administrator offers simplicity, transparency, and ease of access to members of the public.
- Coordination between state and federal wildlife agencies should be considered to anticipate potential delisting of the gray wolf and its implications for game damage compensation and management.
- Local NGOs and coalitions may have roles to play in funding, stakeholder engagement, information dissemination, training and promotion of conflict risk reduction tools, and communication to inform agency best management practices.

CPW's current game damage program

Background: CPW reimburses for damages caused by big game species to livestock. Wolf damage to livestock is currently included under this program; CPW is considering updates to the program specifically for wolves. Additional information about the current program is linked from the CPW website and from www.wolfengagement.co.org.

Summary of TWG feedback: There are various considerations for whether and how the current program should be evolved specifically for wolves. There is general consensus regarding the value of consistency of process, however there are a variety of opinions on whether there should be differences in compensation eligibility, amount and/or criteria. Many TWG members suggest technical merit in consistency in using the existing program, however the TWG also recognizes that there are various social considerations on this topic as well that the SAG will weigh in regarding whether and how the current program should be evolved for wolves.

Discussion and rationale:

- If the current program is effective and well-respected, there is value to both livestock producers and wildlife managers in consistency of approach to game damage across different species of predators. At the very least, consistency of the process used streamlines ease, access, timeliness, and administration. There are technical arguments as well for treating all predators similarly rather than differentiating wolves as unique from other predators.
- The wolf restoration effort could be an opportunity to make improvements to the current program, such as incorporating incentives for non-lethal conflict prevention or minimization tools.
- As wolves are currently a state and federally-protected species, livestock producers may not have the same management tools available for wolves as for other predators such as bears and lions. If the program changes over time, including based on listing status and available management tools, changes in the compensation program might be appropriate. Any changes should be clearly communicated to the public.
- Generally, for compensation programs for wolves throughout the West, "burden of proof" is often a primary reason for producers to find a compensation program unsatisfactory. Clarity of

who investigates, how investigations occur, and how to make the claims process more accessible and efficient for producers are key components of a successful compensation program.

- The TWG anticipates that there are a variety of social considerations that the SAG might discuss affecting whether and how compensation amount, eligible expenses, and/or other criteria should be modified for wolves as compared to the current program.

Non-lethal conflict risk reduction

Feedback on practices and programs

Background: Non-lethal conflict risk reduction techniques are employed to prevent livestock conflict, and include strategies such as management intensive grazing, livestock guard dogs, carcass management, riders and herders, fladry, scare devices, high risk landscape management, and herd composition.

Summary of TWG feedback: Adoption of non-lethal conflict risk reduction techniques by livestock producers in Colorado is important to the long-term success of the wolf restoration and management program. Their effectiveness is context-specific and not well quantified. Various considerations for how to disseminate and facilitate adoption of conflict risk reduction techniques were also discussed. *Note: This report does not address lethal management for conflict risk reduction.*

Discussion and rationale

- The adoption of conflict risk reduction techniques by producers as both a proactive and reactive (post-depredation) approach to livestock conflict will be important to the long-term success of wolf management in Colorado.
- Experiences with livestock producers in other states also suggests that incentivizing and allowing creativity in conflict risk reduction approaches and working with producers is an effective approach.
- Context-specific considerations for effectiveness and feasibility of use of conflict risk reduction techniques include livestock type, age, time of year, land size, other land uses, landscape conditions, and local geospatial features, among other considerations that may impact livestock operations and wolf predation behaviors.
- Quantifying the effectiveness of various non-lethal tools is difficult and research in this area is in development, suggesting effectiveness is highly context-specific and requires some trial.
- The effectiveness of translocation of conflict wolves may vary, and some landscape conditions, independent of individual predator or pack reputation or conflict minimization, may create conflict hotspots.
- Suggestions for dissemination of non-lethal tools included building upon and/or leveraging relationships with members of the agricultural community, including through agency outreach (CPW, USDA APHIS-WS, and/or Colorado Department of Agriculture), community collaboratives, NGOs, stakeholder groups and livestock producer associations, rancher-to-rancher engagement and training programs, academic programs such as Colorado State University Extension, and conflict risk reduction cooperatives.
- Providing funding support, either directly or through cost-share programs, may help to foster adoption of techniques.

Non-Lethal risk reduction requirements for compensation

Background: The TWG discussed technical considerations regarding requirements that non-lethal risk reduction techniques be used prior to depredation to be eligible for compensation.

Summary of TWG feedback: TWG members emphasized the importance of encouraging non-lethal risk reduction techniques, however there were various perspectives regarding the technical merit and feasibility of requiring their use in order to receive damage compensation. The TWG discussed context-specificity of non-lethal risk reduction practices and losses, importance of maintaining flexibility rather than prescribing practices, difficulty in defining risk reduction requirements, value in strategies to incentivize adoption and creative problem solving, and maintenance of relationships with local producers.

Discussion and rationale

- As stated above, the context-specific effectiveness of non-lethal conflict risk reduction tools may suggest that the requirement of techniques may not always lead to conflict reduction, and flexibility in tool use should be prioritized.
- Questions around the assessment burden on agency staff, what should be required, and how conflict risk reduction should be assessed and regulated arose as important considerations.
- Requirement of non-lethal risk reduction techniques may also shape the technical and social value of these tools: some producers may simply use them to fulfill the requirement, while others may invest a lot of time and effort into conflict reduction. This variability complicates implementation of risk reduction requirements.
- Some producers will likely view additional requirements to be another unfunded mandate, which may strain or harm relationships between local agency officials and producers.
- Whether or not non-lethal conflict risk reduction techniques are required for compensation, development of programs to alleviate the financial burden on producers and foster the adoption of techniques may be more effective to achieve conflict reduction.

Appendix A: About the Technical Working Group

The purpose of the Technical Working Group (TWG) is to review objective, science-based information as well as provide its own knowledge and experience at the state/federal/tribal level to inform the development of the Colorado Wolf Restoration and Management Plan. The TWG is composed of members who bring experience in wolf reintroduction, wolf management, conflict minimization, depredation compensation, and other relevant topics. CPW is responsible for writing the Wolf Restoration and Management Plan. The Parks and Wildlife Commission (PWC) serves as the decision-making body responsible for approving the Wolf Restoration and Management Plan. The TWG serves in an advisory capacity to Colorado Parks and Wildlife, offering non-binding input into the development of plan content. The TWG is not a decision-making body and has no authority on wolf management policy, research, or operations. The TWG operates by consensus. For purposes of the TWG, consensus refers specifically to general agreement, or lack of objection, that an option or alternative has sufficient technical merit to be recommended for consideration by CPW. In the absence of consensus, dissenting views will be documented.

Technical Working Group Members:

Scott Becker	U.S. Fish and Wildlife Service, Regional Wolf Coordinator
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Stewart Breck	National Wildlife Research Center U.S. Department of Agriculture, Research Wildlife Biologist
Roblyn Brown	Oregon Department of Fish and Wildlife, Wolf Program Coordinator
Wayne East	Colorado Department of Agriculture, Agricultural/Wildlife Liaison
Justin Gude	Montana Fish Wildlife and Parks, Research and Technical Services Bureau Chief
Jonathan Houck	Gunnison County Commissioner
Mike Jimenez	U.S. Fish and Wildlife Service, Retired
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Technical Working Group report developed with third party facilitation from Keystone Policy Center.

Appendix G: Final Report on Technical Recommendations for Colorado State Listing/Delisting Thresholds and Phasing

Colorado Wolf Restoration and Management Plan Technical Working Group (TWG) to Colorado Parks and Wildlife (CPW)

Final Report on Technical Recommendations for Colorado State Listing/Delisting Thresholds and Phasing

May 2022

Background & Purpose

This document summarizes the Wolf Restoration and Management Plan Technical Working Group (TWG) recommendations regarding population recovery thresholds for downlisting and delisting gray wolves from the state endangered species list in Colorado. As of February 10, 2022, wolves are listed under the Federal Endangered Species Act as Endangered. This effort does not replace a federal recovery plan, nor does it outline federal recovery goals. This effort describes state management of a species for when management authority is returned to the state (i.e., federally delisted). This effort may inform development of federal rulemaking processes in the interim, in particular consideration of development of a 10(j) Experimental, Non-Essential designation.

The thresholds were developed through expert deliberation of TWG members and are presented in a phased framework. While the determination of these thresholds is a technical exercise, management actions corresponding to the phased framework should be informed by legal and social considerations, which will be addressed largely by the Stakeholder Advisory Group (SAG). The framework is presented below (page 2) and is followed by a summary of TWG discussion and rationale.

Colorado State definitions for state endangered and threatened species are as follows:

- Endangered Species (CRS 33-1-102 (12)): any species or subspecies of native wildlife whose prospects for survival or recruitment within this state are in jeopardy as determined by the commission.
- Threatened Species (CRS 33-1-102 (44)): any species or subspecies of wildlife which, as determined by the commission, is not in immediate jeopardy of extinction but is vulnerable because it exists in such small numbers or is so extremely restricted throughout all or a significant portion of its range that it may become endangered.

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Colorado Gray Wolf Population Listing/Delisting Phased* Framework

	Phase 1 <i>(correlating with State Endangered status)</i>	Phase 2 <i>(correlating with State Threatened status)</i>	Phase 3 <i>(correlating with State delisted, nongame status)</i>	Phase 4 <i>(correlating with State delisted, game status)</i>
Start	Current (2022)	Minimum count of 50 wolves anywhere in Colorado for four successive years.	Phase 1 and Phase 2 conclusion requirements are both met. Phase 2 requirements may be met concurrently with Phase 1 requirements.***	Discretionary phase, not prescriptive nor legally required. A population estimate above the delisting threshold would be required.
Conclude	Minimum count** of 50 wolves anywhere in Colorado for four successive years.***	Minimum count of 150 wolves anywhere in Colorado for two successive years**** -OR- Minimum count of 200 wolves anywhere in Colorado with no temporal requirement.	No prescribed conclusion; not legally required.	No prescribed conclusion.
Action upon conclusion	Downlist to State Threatened.	Delist from Colorado State list	Consider reclassifying to game species.	N/A
Criteria to move back into this phase	After downlisting, a minimum count of less than 50 wolves anywhere in Colorado for two consecutive years initiates review of relisting to State endangered status.	After delisting, a lower bound of a population estimate of less than 150 wolves anywhere in Colorado for two consecutive years initiates review of relisting to State threatened status.	To be determined depending on whether and under what criteria a game reclassification is made.	N/A

Notes on framework:

*Phases will be dictated by numeric and temporal wolf population thresholds described in the table. While it is intended that state status will also correspond to these thresholds, there may be a time lag as the Parks and Wildlife Commission undertakes the procedural process to change the state status based on population counts.

**Minimum population counts in any phase include gray wolves that have been reintroduced to Colorado and those that have naturally migrated into the state and their progeny. Wolf population minimum counts in this table refer to counts conducted in late winter to most accurately reflect recruitment.

***“Successive” means years in a sequence, with any number of gaps in between. Consecutive means years in a sequence with no gaps. The rationale for using a metric of successive years is to account for potential years when an adequate survey cannot be conducted.

****Downlisting to State Threatened status may not occur until the four-successive year requirement is met in the State Endangered status phase 1 (Phase 1). However, the two-successive year timeline for the phase 2 minimum count requirement begins when the minimum number is first met and may occur concurrently while in the Phase 1/endangered phase. Consequently, it is possible that delisting (Conclusion of Phase 2) may occur immediately after Phase 1, should the Phase 2 requirements be met concurrently during Phase 1.

Discussion and Rationale

The TWG generally **supports a phased approach** to gray wolf downlisting, delisting, and management:

- It provides clarity for current and future management while supporting the statutory goal of managing for a self-sustaining wolf population.
- It can allow for increasing management flexibility as the wolf population increases, as well as for flexibility to manage conflict throughout all phases.
- Other states have similarly used phased approaches to managing their wolf populations.
- It is important to maintain public trust in CPW in each phase of restoration and management by being responsive to current and future conditions of conflict, social conditions, and wolf population trends.
- Thresholds for phasing are based on best available science and meet all requirements under state statute.
- Some members suggested that linking the specific population metrics, rather than state listing status, to management options would lend to more management flexibility – particularly if delisting actions are tied up in litigation when the population hits the corresponding population metric. However, others suggested linking listing status directly to management phases would simplify messaging and expectations for field staff and members of the public. The difference in management options currently allowed under State law for endangered and threatened listing statuses is relatively inconsequential. The framework suggests that the population metrics should correspond with state status, but they are not directly linked: it is expected that once the wolf population reaches the metrics defined for downlisting/delisting, the management flexibility defined by the subsequent phase will be immediately in place, while at the same time the Colorado Parks and Wildlife Commission undertakes the processes to take the necessary action to down/delist the species. There may be a procedural delay when moving from Phase 2 to Phase 3.

The TWG generally **supports minimum population count with a temporal threshold to downlist wolves from state endangered to state threatened and to delist wolves.**

- *Rationale for recommendation of minimum population count as the relevant metric for downlisting and delisting:*
 - The social behaviors and resiliency of wolf populations, specifically wolves' tendency to form packs and documented reproductive success, support a minimum population count to satisfy the technical specifications of CRS 33-2-105.8 to restore a self-sustaining population of wolves to Colorado.
 - At the population level, the reproductive potential of a greater number of smaller packs or a smaller number of larger packs does not significantly differ and thus supports population counts rather than a minimum number of packs, although tracking pack statistics may be useful to document population stability and growth.
 - There are differing definitions of a 'pack' found in the scientific literature and in different states' management plans. In various contexts, a pack has been defined as 2 wolves, 4 wolves, or a breeding pair and two litters from different years.

- Defining management thresholds around breeding pairs will be difficult and expensive to monitor as the population grows.
- Geographic distribution metrics were discussed as potential thresholds, but some suggested that this may be at odds with Colorado's 2004 wolf working group recommendations to allow wolves that do not cause conflict to live without bounds.
- A minimum count is recommended in the early phases of reintroduction. A minimum count is more labor and resource intensive; however, it is beneficial for accuracy of monitoring and both technical and social confidence in informing downlisting and delisting decisions and management. Minimum population counts can be more accurate at lower population sizes than they are at higher population sizes.
- As the wolf population grows, minimum population counts are more difficult to conduct and are less reliable for understanding total population size.
 - As the wolf population grows larger, and upon transition to delisted status, consider the use of a minimum population estimate and/or population models as a more reliable metric, i.e., models based on distribution, vital rates, and abundance estimates, etc.
 - Minimum counts will be important to compare with population estimates throughout phases 1 and 2, and population estimates can validate minimum counts.
 - Weather, staffing, and other unforeseen events can affect ability to conduct minimum counts.
- *Rationale for temporal component to minimum population metric:*
 - A temporal threshold of multiple successive years after minimum population counts were met in each phase was suggested as a measure of persistence in population trends.
 - Members suggested interaction between minimum population count and the length of time could accommodate rapid or slow population growth. For example, rapid population growth could eliminate the need for a temporal requirement between phases.
 - 'Successive' means years in a sequence, with any number of gaps in between. 'Consecutive' means years in a sequence with no gaps.
 - Members suggested that a temporal requirement of successive minimum population counts for downlisting are important to ensure a trend of a stable or increasing population, to account for the potential temporary population increases that may occur through reintroduction, and to allow for temporary fluctuations in population and/or unforeseen monitoring challenges over time.
 - Members suggested that review of State relisting (to threatened or endangered status) should be initiated when thresholds are not met for two consecutive years; this allows for potential temporary population decreases and/or unforeseen monitoring challenges that may affect minimum count while also initiating timely review should counts fall below threshold two years in a row.
- *Additional considerations for minimum population counts:*
 - Minimum counts for delisting are NOT intended as population objectives or maximums.

- In recommending specific minimum population counts for downlisting and delisting, the TWG cited wolf population trends, modeling efforts, other wolf recovery efforts, literature review of population modeling, and criteria for phased management elsewhere.
 - Minimum counts should include wolves that have naturally migrated to Colorado and their progeny as well as those that were reintroduced.
 - While wolf monitoring occurs throughout the year, the wolf population minimum count to inform downlisting/delisting decisions should be held in late winter to reflect recruitment most accurately.
- *Considerations for spatial distribution and ecological niche:*
 - The social and spatial tendencies of gray wolves suggests that 150-200 wolves would distribute among several million acres of territory in Colorado; spatial occupancy can be estimated based on literature regarding pack and territory size.
 - Minimum population count as a metric for State downlisting and delisting is thus correlated with spatial distribution.
 - Spatial distribution, ecological function and the 3Rs model (representation, redundancy, resiliency) are important considerations and goals for conservation.
 - Given the large-scale movements and natural history of wolves, the 3Rs approach is more relevant for larger or range wide conservation (i.e., throughout all the Lower 48 contiguous United States); however, it is less relevant at the scale of Colorado for state reintroduction and down/delisting metrics.
 - Positive ecological effects from having wolves on the landscape can occur, however they are difficult to quantify and document, require appropriate scale, and are also situation-specific.
 - Ecological effectiveness is a vague concept and situation-specific; for example, positive effects of a full complement of large carnivores in Yellowstone may not apply in other areas.
 - Ecological effectiveness and trophic cascades across a large area do not fully occur until there is a saturated wolf population. However, social carrying capacity and conflict in human-dominated landscapes will impact pack size and distribution and will likely limit achievement of ecological carrying capacity.
 - Landscape level ecological effects are thus both difficult to quantify and to achieve and are not appropriate as a metric or criteria for State downlisting and delisting.
- *Considerations for connectivity:*
 - Measures of genetic health and/or connectivity, such as measuring adequate heterozygosity from blood or tissue samples, are important metrics that should be periodically monitored over time as an indicator of a self-sustaining population.
 - Indicators of genetic connectivity are not necessary as a threshold for State downlisting and delisting. If wolves from the Northern Rockies or Pacific Northwest are sources for reintroduction, and wolves continue to disperse into Colorado from neighboring areas, the genetic makeup of Colorado wolves will already reflect the genetics of these areas. Colorado's wolf population is demographically connected to other populations in the Northern Rockies. Colorado thus does not require higher numeric population downlisting/delisting thresholds set for other locations that lack spatial connectivity.

- *Considerations for species reclassification and management after wolves are delisted:*
 - As noted above, connectivity is an important indicator for long-term monitoring, as it contributes to a self-sustaining population.
 - Reclassification of gray wolves from nongame to game status would be a phase discretionary to the Colorado Division of Parks and Wildlife, rather than a prescribed phase. Reclassification to game species is not legally required nor discussed by statute CRS 33-2-105.8.
 - Determination of whether to move to game classification should include consideration of social input regarding acceptability of wolf harvest and means of take, demand for population size management, livestock conflicts, impacts on other wildlife populations, other impacts from conflict, and/or demand for harvest opportunity. Many game populations in Colorado are managed to achieve a population size or trend objective, which will be an important consideration when this determination is made. There are advantages to early discussion on this topic; however, learning will also occur over time.
 - There should be clarity on the objectives of reclassification, for example, more liberalized management of conflict vs. management of populations through regulated hunting.
 - Consideration of reclassification should require maintenance of a minimum population estimate greater than the delisting threshold, with a sufficient buffer to avoid the need to relist.

Appendix A: About the Technical Working Group

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Technical Working Group report developed with third party facilitation from Keystone Policy Center.

Appendix H: Final Report on Technical and Experiential Feedback on Wolf Management Considerations

Colorado Wolf Restoration and Management Plan Technical Working Group (TWG) to Colorado Parks and Wildlife (CPW)

Final Report on Technical and Experiential Feedback on Wolf Management Considerations August 2022

Background & purpose

This document summarizes the Wolf Restoration and Management Plan Technical Working Group (TWG) discussions regarding technical and experiential feedback on a variety of wolf management issues, including perspectives on biological relevance, ability to quantify and/or measure impacts, impact on technical outcomes, feasibility for managers, and experiences with and/or in implementing programs in other states.

This document is not intended as a literature review nor as a definitive set of recommendations regarding wolf management in Colorado. Rather, it offers a consensus-based synthesis of key takeaways from the TWG – based on its in-depth knowledge and practice of biological science and wolf management – to help inform the wolf restoration and management plan that will be developed by Colorado Parks and Wildlife.

The TWG recognizes that there are various social considerations for impact-based management that the Stakeholder Advisory Group (SAG) has discussed in informing an impact-based management plan for Colorado. A recurrent theme across many topics is to consider trust – including trust in managers, messengers, and stakeholders – as an input for effective management, and conversely to consider how to address lack of trust as a barrier to effective management.

Key takeaways

- **Conflict-centered management vs. objective-based management:** Wolf management should focus on management of conflict, with consideration of the social factors that accompany an impact-based management approach. Lessons from other states with wolves suggest population management is not robustly correlated with conflict minimization. Generally, the public has a high expectation that state wildlife agencies will address wildlife related challenges.
- **Avoiding misinterpretation of maximum vs. minimum population metrics:** It is important to use clear and consistent messaging to reinforce the purpose of minimum population counts/estimates, which are not intended as population objectives or maximums and have been misinterpreted in other contexts.
- **Zonal management:** Initial and long-term management should be impact-based. Zonal management of conflict could be a consideration for future management. Delineation of zones in the future could be informed by experience and data gathered through impact- (and conflict-) based management, understanding of ecological and social suitability (inclusive of wildlife and agricultural interests), and learnings from wolf dispersal and establishment on the ground.

- **Wolf population self-regulation:** Intrinsic self-regulation of wolves is unlikely at a statewide scale; wolves will likely be extrinsically regulated particularly by social carrying capacity. Wolf population self-regulation does not achieve the same goals as conflict management.
- **Positive impacts and wolf management:** Positive and negative impacts can occur due to wolf presence; positive impacts do not generally require hands-on management but can be communicated through education and outreach and can inform management activities and funding opportunities.
- **Non-lethal livestock conflict minimization:** Adoption of proactive and reactive non-lethal conflict risk reduction techniques by livestock producers in Colorado is important to the long-term success of the wolf restoration and management program. The effectiveness of these tools is context-specific and not well quantified.
- **Post-depredation management of conflict wolves:** While wolf depredations on livestock in other states are uncommon and do not represent a notable burden to the livestock industry as a whole, some wolves do cause significant problems for some ranchers and some areas experience repeated and frequent wolf depredations on livestock. Management of wolf-livestock conflicts following depredations should allow flexibility for managers; non-lethal and lethal management techniques should be applied adaptively and are context-specific. To be effective at reducing further depredation events, lethal and non-lethal responses for resolving conflict should be applied quickly and properly. Relocation of depredating wolves has little technical merit.
- **Lethal management of conflict wolves:** Lethal and non-lethal management are both critically important tools for conflict minimization; lethal management will likely attract greater social attention. In evaluating the management approach on a context-specific basis, consider the trade-offs among ability to target depredating wolves, conflict minimization efficacy, cost, reproductive and recruitment success, wolf population size and listing status, impacts to livestock producers, and social/stakeholder interests when considering lethal take options, including incremental and whole pack removal.
- **Considerations for ecological effects:** Ecological function is an important factor to consider but is difficult to quantify and may be less relevant as a metric at the state scale.
- **Impacts of wolves to ungulates, big game, and big game hunting:** Although statewide impacts to ungulate populations and hunting opportunities have not occurred in other states and are unlikely in Colorado, wolves can have local impacts to ungulate recruitment due to predation of young ungulates. Wolves prefer elk and will also prey on deer and other ungulates; moose may be targets of predation where they are abundant. Reduction in big game hunting opportunities and targeted wolf control have sometimes occurred locally in other states to address negative ecological or economic effects of reduced ungulate populations. Ungulate populations are impacted by a complexity of interacting factors.
- **Impacts of wolves to prey compromised by infectious disease:** Predators like the gray wolf may select for prey compromised by infectious diseases, which could prove useful in reducing infectious disease prevalence in ungulate populations, primarily when pathogens are directly

transmitted among hosts. The strength of a potential disease reduction depends on numerous factors, including specific disease etiology, the strength of selection for infectious individuals, and overall predation rates. It is unclear whether wolves will have a measurable effect on chronic wasting disease (CWD) in Colorado, where environmental contamination is likely to be a primary transmission route and where CWD is already well-established in mule deer, a species that wolves generally do not select for in the presence of elk.

- **Interactions with other wildlife species:** Wolves are important components of trophic networks where they are present on the landscape and their presence may have interactions with other large carnivores. The presence of wolves will not have an impact on populations of threatened and endangered species in Colorado, specifically lynx and Gunnison sage grouse.
- **Management of conflict with humans:** Attacks by wolves on humans are exceedingly rare; education and outreach for recreationists and other public lands users should include best practices and guidance, including how to differentiate wolves and coyotes. Flexibility to address rare instances of wolf habituation in areas dominated by humans is important.
- **Management of conflict with pets and hunting dogs:** Wolf attacks on pets are uncommon; education, outreach, and management should be used to proactively prevent conflict. It is important that public messaging emphasizes the risks assumed when domestic and hunting dogs are present in areas with wolves.
- **Wolf monitoring and expectations for stakeholders and public:** Monitoring and research should be based on restoration and management goals, use a variety of techniques, and be connected to other elements of wolf management, including conflict minimization. While robust monitoring is valuable at early stages of reintroduction, limitations to monitoring will increase with wolf population growth, requiring transition to a population estimate approach. It is important to consider effective messaging and coordination with stakeholders and the general public when communicating monitoring objectives and data; lead with trust and share data on an as-needed basis.
- **Social and/or economic dimensions of wolf management:** Social and economic dimensions are critical to understand, measure, and incorporate into decisions on wolf management. Perceptions of wolves and perspectives on management vary among people, are generally consistent within interest groups, and often reflect deeply held beliefs and values. There is high potential for social controversy and conflict, particularly as related to expectations and acceptance for use of non-lethal practices, lethal control, recreational harvest/regulated public hunting, and wolf population numbers. Some research suggests that economic benefits can be substantial and much larger than economic costs, however economic benefits and costs are not distributed equally across stakeholders and the public. Consider the breadth of existing social science research, economic indicators, and stakeholder and public feedback when making management decisions, and incorporate new social and economic research into future decisions. Education and outreach can also inform and be informed by social science. It is critical to have trusted, responsive managers on the ground and consistency of management.

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Wolf population management

Conflict-centered management vs. objective-based management

Summary of TWG Feedback: Wolf management should focus on management of conflict, with consideration of the social factors that accompany an impact-based management approach. Lessons from other states with wolves suggest population management is not robustly correlated with conflict minimization. Generally, the public has a high expectation that state wildlife agencies will address wildlife related challenges.

- Focus on conflict-centered management properly scaled for issues involving livestock, ungulates, etc.
 - Have a systematic and flexible plan to be able to support and respond proactively and reactively to minimize conflict.
 - Impact-based management alone will not necessarily satisfy the needs and interests of those that are concerned about wolf populations on the landscape.
 - Impact-based management may also not satisfy the interests and concerns of those that want wolves on the landscape.
- The link between wolf population management (i.e., developing population objectives and managing towards those objectives) and conflict reduction is not necessarily robust on a statewide basis.
 - There may not necessarily be more depredations with higher statewide wolf populations (at some level, there are more conflicts as the population increases but these do not necessarily have a linear relationship).
 - Wolf population size and frequency of depredations do not share a linear relationship at a Statewide scale in the northern Rocky Mountain states and other states. Conflict minimization (lethal and non-lethal) play a role in this pattern in other states.
 - Depredations are more common in places with higher wolf density and livestock density at the local scale.
- Effective management of livestock, big game and other conflicts at a local scale are distinct as management issues from population objectives and population management over larger scales. That is to say that local, impact-based management (managing to resolve conflicts) is different than statewide management for population objectives. Diverse stakeholders need to be involved at both scales, i.e., in defining approaches to local conflict management and determine population size management over larger scales.
- A population objective is not required for diverse stakeholder involvement in statewide population management. Consensus on whether a population objective is needed or what it might be has not been achieved among public advisory councils in other states, and similarly the TWG could not reach consensus on this. A variety of biological and social considerations affect this issue.
- *If* a population objective is considered in the future:
 - Any population management objective should be based in biological and social science, including an understanding of social carrying capacity determined over time.
 - If a wolf population objective is established, it is difficult to manage to that objective through conflict management alone.
 - If using regulated hunting for population management toward a population objective, efficacy of regulated hunting depends on when the objective is set (i.e., the population

at that time), what it is set at, and what other management and allowance for lethal take are in place. Insights from other states suggest that regulated hunting is likely more effective to maintain or achieve that objective when the wolf population is smaller.

- TWG members do not have agreement on whether a population objective should be established. Some members expressed concern in wildlife managers' ability to maintain adequate pace of response to conflict as wolf populations grow. Some members suggested that proactive management - setting and managing towards local or statewide population objectives - may help to mitigate potential management capacity issues. Other members do not support the need for statewide population objectives.

Avoiding misinterpretation of maximum vs. minimum population metrics

Summary of TWG feedback: It is important to use clear and consistent messaging to reinforce the purpose of minimum population counts/estimates, which are not intended as population objectives or maximums and have been misinterpreted in other contexts.

Note: Please see TWG's separate report on recommendations and rationale regarding minimum population thresholds and metrics for State downlisting and delisting.

- Minimum population counts for downlisting and delisting are not intended as and should not be interpreted as population objectives nor maximums.
 - Be clear and consistent in the messaging of this; reinforce the message constantly at the highest levels of leadership within the State.
- Trust in the agency and its managers on the ground, along with its responsiveness and engagement with the public, is important for the management of population size and other topics.
- Public and stakeholder focus on the minimum as a maximum is indicative of various interests or concerns about wolves on the landscape, for example, concerns about livestock conflict, ungulate impacts, ecological benefits, etc.

Zonal management

Summary of TWG Feedback: Initial and long-term management should be impact-based. Zonal management of conflict could be a consideration for future management. Delineation of zones in the future could be informed by experience and data gathered through impact- (and conflict) based management, understanding of ecological and social suitability (inclusive of wildlife and agricultural interests), and learnings from wolf dispersal and establishment on the ground.

- Zonal management is a consideration for how to address social and ecological dynamics and conflicts. Zonal management is the concept whereby different local areas are managed differently with respect to the tradeoff between wolf conservation versus local wolf conflicts while considering wolf population goals and trends at a larger scale. Conflicts refer to those with livestock and big game, or other, less likely, interactions with humans, pets, or other species. Management in some areas may be focused on wolf population conservation and growth while management in other areas may have higher wolf mortality rates to proactively minimize impacts on big game or livestock depredation, so long as overall wolf population size or growth are adequate.

- Zonal management does *not* refer to geographic recovery area; the TWG has proposed Statewide recovery thresholds for Colorado.
- Zonal management does *not* refer specifically to management based on population objective, but rather based upon ecological and social suitability and conflict.
- Above minimum population thresholds, zonal management can be used with management favoring different outcomes (e.g., wolves, agriculture) where social and ecological conditions support them.
 - Consider the Colorado State University (CSU) and US Department of Agriculture Animal and Plant Health Inspection Service- Wildlife Service (USDA-APHIS-WS) model for habitat suitability/conflict to inform zonal management: this includes social and ecological factors.
 - This model suggests the existence of ecological and social suitability in Colorado, with low conflict, to support zonal management.
 - Truthing the model with data collected from wolf monitoring in Colorado will help to validate it prior to establishing any zonal management in the state.
- A consideration for timing of implementation of zonal management is that where wolves are released is not necessarily where they will end up: this includes consideration that Proposition 114 requires release west of the Continental Divide but introduced wolves will almost certainly move east of the Divide and naturally migrating wolves are already present east of the Divide. Delineation of management zones is best informed with experience and data on wolf establishment and distribution on the ground.
- Delineation of wolf management units with lines on a map is complex, should be informed by Colorado-specific data and goals, and should embed flexibility over time based on management learning and experience. For example, in Montana, the decision to apply zonal management was made with 15 years of data on wolves on the landscape.
- Impact/conflict-based management can occur without zonal management; i.e., rather than drawing lines on maps, manage based on impacts in areas that emerge from the experiences on the ground. Impact/conflict-based management can also inform the development of zonal management over time, such that zones are delineated and managed according to the emergent patterns of impacts.

Wolf population self-regulation

Summary of TWG feedback: Intrinsic self-regulation of wolves is unlikely at a statewide scale; wolves will likely be extrinsically regulated particularly by social carrying capacity. Wolf population self-regulation does not achieve the same goals as conflict management.

- Wolves are territorial; intrinsic self-regulation occurs at a high population density: in combination with extrinsic regulation (see below) this can also be referred to as ecological carrying capacity.
- Self-regulation may be possible at a smaller scale but is unlikely to be seen at a statewide scale; population density necessary for statewide self-regulation is unlikely to be seen in Colorado.
- Wolves will adjust to food supply (extrinsic regulation) below the level at which intrinsic population control limits the population size or growth rate.
- Wolf population self-regulation is not a substitute for conflict management. Managers will have to address conflict management before a wolf population reaches a point where it is functioning at ecological carrying capacity, or the combination of extrinsic and intrinsic self-regulation.

Positive impacts and wolf management

Summary of TWG feedback: Positive and negative impacts can occur due to wolf presence; positive impacts do not generally require hands-on management but can be communicated through education and outreach and can inform management activities and funding opportunities.

- Positive and negative impacts can occur due to wolf presence on the landscape; these can include ecological, social and economic impacts as discussed in sections below.
- Positive impacts can be communicated and supported through education, information, and outreach. For example, managers could share distribution maps (general areas, not den locations or other sensitive data) to support wolf tourism (viewing, howling). Consider both the positive and negative impacts of increasing tourism.
- Positive impacts generally do not require hands-on-wolf management. However, where positive impacts exist, they could inform management; for example, if there are positive impacts in a park, consider managing for them by creating a buffer for management around that area.
- Some literature indicates that while the economic benefits of wolves can be many times higher than the costs of management to prevent and resolve conflicts, the distribution of benefits do not align with the distribution of costs. Positive impacts could inform funding and support for wolf management.

Management of livestock conflict

Non-lethal livestock conflict minimization

Summary of TWG feedback: Adoption of proactive and reactive non-lethal conflict risk reduction techniques by livestock producers in Colorado is important to the long-term success of the wolf restoration and management program. The effectiveness of these tools is context-specific and not well quantified.

- Non-lethal conflict reduction techniques include those implemented prior to and to prevent conflict as well as those implemented following depredation to prevent further conflict.
- To be most effective at minimizing and preventing depredation events, non-lethal conflict techniques should ideally be applied early and properly when wolves are in or anticipated in an area. To accomplish this, advanced preparation and engagement among the agency, partners, livestock producers, nonprofits, and others working on conflict minimization in Colorado is strongly advised prior to and continuing through reintroduction.
- Experiences with livestock producers in other states also suggests that incentivizing and allowing creativity in conflict risk reduction approaches and working with producers is an effective approach.
- Context-specific considerations for effectiveness and feasibility of use of conflict risk reduction techniques include livestock type, age, time of year, land size, other land uses, landscape conditions, and local geospatial features, among other considerations that may impact livestock operations and wolf predation behaviors.
- Quantifying the effectiveness of various non-lethal tools is difficult and research in this area is in development, suggesting effectiveness is highly context-specific and requires some trial.

- Suggestions for dissemination of non-lethal tools include building upon and/or leveraging relationships with members of the agricultural community, including through agency outreach (CPW, USDA APHIS-WS, and/or Colorado Department of Agriculture), community collaboratives, NGOs, stakeholder groups and livestock producer associations, rancher-to-rancher engagement and training programs, academic programs such as Colorado State University Extension, and conflict risk reduction cooperatives.
- Providing funding support, either directly or through cost-share programs, may help to foster adoption of techniques.

Post-depredation management of conflict wolves

Summary of TWG feedback: While wolf depredations on livestock in other states are uncommon and do not represent a notable burden to the livestock industry as a whole, some wolves do cause significant problems for some ranchers and some areas experience repeated and frequent wolf depredations on livestock. Management of wolf-livestock conflicts following depredations should allow flexibility for managers; non-lethal and lethal management techniques should be applied adaptively and are context-specific. To be effective at reducing further depredation events, lethal and non-lethal responses for resolving conflict should be applied quickly and properly. Relocation of depredating wolves has little technical merit.

- A guiding principle for management should be to allow wildlife managers flexibility, such as in defining a problem and/or conflict wolf and/or chronic depredation.
- Chronic depredation would consist of multiple depredations and could consider temporal and spatial factors (e.g., from other states: two depredations in a calendar year, three within ninety days, or four within a relative nine-month window from first depredation), as well as the phase of recovery and management. Simplicity should be a guiding factor in this definition. A potential definition for a conflict wolf would be a wolf that creates conflict, not exclusive to but including depredation.
- Management response may vary between one or multiple depredations, and depredation response may not always be driven solely by depredation frequency. For example, lethal removal might be an effective way to reduce future depredations after an initial depredation event if the wolf population is large enough, and implementation of non-lethal deterrents may be effective after multiple depredation events in a small pasture situation.
- It can be difficult to determine which individual wolf or pack is depredating, and an alternative could be to consider depredation by area, such as focusing on depredations affecting a producer and/or community rather than on the individual wolves and/or packs. Knowledge of areas where conflict is more likely to occur will increase over time, and adaptive responses can be tailored based on this knowledge. Areas with higher wolf density and livestock density tend to be those with higher conflict.
- Efficacy of non-lethal techniques vary on a case-by-case basis, including factors such as if a depredation has already occurred as well as spatial and temporal conditions for when and how the depredation occurred.
 - While efficacy of non-lethal methods may decrease over time or after an initial depredation, implementation of non-lethal methods and aversive conditioning post-depredation have had success to prevent further depredations and prevent use of lethal management actions.
 - A specific example of an effective non-lethal technique is the removal of bone piles and other attractants, ideally pre-depredation, or potentially post-depredation.

- Some landscape conditions, independent of individual predator or pack reputation or conflict minimization, may create conflict hotspots.
- The effectiveness of translocation of conflict wolves may vary. Relocation of conflict wolves has little technical merit and presents a social challenge in relocating a known depredator elsewhere.
 - Those wolves might attempt to return back to their original location and/or create problems for producers in other places.
 - Relocation takes significant time and resources.
 - If the purpose of relocation is to stop further depredations, it is important to consider whether this accomplishes that purpose.
 - This practice has only been previously used if managers do not have flexibility via regulation to use other conflict wolf management tools.

Lethal management of conflict wolves

Summary of TWG feedback: Lethal and non-lethal management are both critically important tools for conflict minimization; lethal management will likely attract greater social attention. In evaluating the management approach on a context-specific basis, consider the trade-offs among ability to target depredating wolves, conflict minimization efficacy, cost, reproductive and recruitment success, wolf population size and listing status, impacts to livestock producers, and social/stakeholder interests when considering lethal take options, including incremental and whole pack removal.

- Availability of both lethal and non-lethal management tools is important to support management flexibility.
- Lethal management of wolves will be accompanied by significant social attention in Colorado.
 - Some social science research suggests Coloradans are least likely, compared to other states in the region, to support lethal management and that non-lethal tools will need to be an integral part of management.
 - Wildlife damage management research has consistently shown the affected public supports lethal management and the unaffected public generally does not support lethal management regardless of species involved.
 - Proper emphasis and exercise of non-lethal techniques, quality of investigations, agency transparency and education and outreach about conflict management and conflict wolves should be among factors considered prior to justifying lethal techniques to respond to and prevent future depredations.
- Targeted lethal control may decrease future depredations. There are tradeoffs between incremental (individual) removal and whole pack removal:
 - There have been both successes and failures with incremental removal.
 - The more wolves that are removed, the higher the efficacy for reducing conflict and reducing likelihood of an additional depredation; however, there is a tradeoff in terms of wolf recruitment, and in some cases, social acceptability.
 - Incremental removal of individuals responsible for the depredation may be more socially acceptable. However, it is difficult to effectively target the individual depredators (due to time, knowledge, and monitoring constraints); consider targeted incremental removal in early phases when managers have the ability to target depredating wolves.
 - Wolf populations can sustain 25-30% annual mortality while maintaining a stable or increasing population. This is well above the level of mortality that would be expected

due to lethal take for management of depredating wolves: however, it does not address the specific ecological and social consequences of lethal removal when only a small number of wolves or packs are present (i.e., early in reintroduction).

- Data do not suggest that depredation will increase due to lethal removal of individual wolves from a pack.
- Lethal take of depredating wolves may increase effectiveness of non-lethal management techniques by removing individuals with bolder behavior and conditioning fear of humans in remaining pack members: however, the science is not robust on this topic.
- Lethal removal is problematic if the individual depredators are also the breeding individuals, which will affect recruitment. The probability of persistence and reproduction decreases as more individual wolves are removed from a pack.
 - If there is not reproduction, lack of pups can lead to pack dissolution.
 - The larger a pack, there will be more resilience to a mortality event and the higher likelihood that the pack will recruit pups the year following removal. However, larger packs are also more likely to depredate again.
 - Seasonality and whether the removed wolves are breeding individuals will also affect pack persistence and reproduction.
- Management options could consider the role of lethal control in areas of public land grazing vs. areas of mixed public and private lands. This was a consideration for phased management in one Northern Rockies state, where more liberal management was included in earlier phases for areas of mixed private and public land, whereas management was liberalized in later phases for public lands. However, differentiation raises challenges for consistency of management. Alternatively, options could consider land use patterns rather than land ownership. There are many areas where public and private lands are interspersed and not fenced; knowing precisely whose land an action occurred on can be problematic. However, it may be possible to consider management based on the general use patterns (agricultural, residential, recreational, wilderness, etc.).
- Public harvest (different than conflict management) has not directly led to a decrease in depredation in areas of harvest in other states, but there are indirect impacts for wolves being sensitized to and fearful of humans as a result of public harvest, which may in turn decrease wolf interactions with and depredations of livestock.

Management of interactions with ungulates and other wildlife species

Considerations for ecological effects

Summary of TWG feedback: Ecological function is an important factor to consider but is difficult to quantify and may be less relevant as a metric at the state scale.

- Positive ecological effects from having wolves on the landscape can occur, however they are difficult to quantify and document, require appropriate scale, and are also situation-specific. Landscape level ecological effects are both difficult to quantify and to achieve.
 - Ecological effectiveness is a vague concept and situation-specific; for example, positive effects of a full complement of large carnivores in Yellowstone may not apply in other areas.

- Ecological effectiveness and trophic cascades across a large area are not likely to occur until there is a saturated wolf population. However, management to address social carrying capacity and conflict in human-dominated landscapes will impact pack size and distribution and will likely limit achievement of ecological carrying capacity.

Impacts of wolves to ungulates, big game, and big game hunting

Summary of TWG feedback: Although statewide impacts to ungulate populations and hunting opportunities have not occurred in other states and are unlikely in Colorado, wolves can have local impacts to ungulate recruitment due to predation of young ungulates. Wolves prefer elk and will also prey on deer and other ungulates; moose may be targets of predation where they are abundant. Reduction in big game hunting opportunities and targeted wolf control have sometimes occurred locally in other states to address negative ecological or economic effects of reduced ungulate populations. Ungulate populations are impacted by a complexity of interacting factors.

Predators like the gray wolf may select for prey compromised by infectious diseases, which could prove useful in reducing infectious disease prevalence in ungulate populations, primarily when pathogens are directly transmitted among hosts. The strength of a potential disease reduction depends on numerous factors, including specific disease etiology, the strength of selection for infectious individuals, and overall predation rates. It is unclear whether wolves will have a measurable effect on chronic wasting disease (CWD) in Colorado, where environmental contamination is likely to be a primary transmission route and where CWD is already well-established in mule deer, a species that wolves generally do not select for in the presence of elk.

- At a statewide level, wolves are unlikely to have a major impact on overall big game populations or hunting opportunities in Colorado based on evidence from northern Rocky Mountain states.
- Ungulate populations are impacted by a complexity of interacting factors.
- Impacts of wolves to ungulates are a local rather than statewide issue; ungulate management in response to gray wolf impacts should also be localized.
- Wolf-prey selection demonstrates a strong preference for elk over deer, where elk are present.
- The impact of predation is focused on recruitment because wolves tend to eat young elk; they will prey on a variety of age classes of different ungulate species (including reproductive and non-reproductive age): however, their preference is for young and old elk. This impact occurs in combination with presence of other predators and ungulate habitat limitations. Wolf predation occurs throughout the year, with some seasonal variability and peak kill rates in late winter.
- In other states where wolves are present with other carnivores, reduction in big game hunting opportunities (particularly cow hunting or through changes in license type) has sometimes occurred to maintain ungulate population size. Declines in ungulate population size have occurred when reductions in recruitment due to predation have occurred in combination with cow hunting. Therefore, recent big game management in other states where wolves are present has focused on reducing or eliminating cow hunting opportunities to avoid population declines.
- In some states, under both federal and state management authority, wolf control may be considered if it was determined that wolves were a contributing factor to negative performance of big game populations.
 - Wolf impacts to ungulate populations are localized, typically occur in the presence of impacts from multiple large carnivores, and examples of impacts and subsequent management of wolf impacts to big game are rare; some areas such as NW Montana and the LoLo area of Idaho have been managed for wolf impacts to big game.

- Under federal management authority, it was only allowed for nonessential experimental populations in States that had Service-approved wolf management plans (i.e., ID, MT, WY), although when this might be considered changed slightly over time.
- Many state wolf management plans also consider wolf impacts to big game populations and when wolf control may be considered to improve the performance of big game populations. These considerations vary by state. In Montana, Idaho and Wyoming, there are regulated hunting seasons. Both Washington and Oregon have very similar language as to what is proposed for how wolves could be managed should there be demonstrated effects on local ungulate populations.
- In addition to considerations for infectious disease and CWD (discussed above), there are considerations for potential wolf effects on ungulate population health and noncommunicable disease. Gray wolves preferentially select for relatively weak prey, including old and diseased (i.e., noncommunicable) prey, which may reduce disease prevalence such as arthritis.
- Moose are generally not a significant portion of wolf diet; however, wolf predation of moose is variable and the impacts to the moose population are localized, dependent in part on the size of the moose population. Wolves are more likely to select moose where moose populations are higher. In Yellowstone, moose are rare and moose predation is low. In locations where moose populations are low, there is potential for relatively higher impacts from wolf predation, even if wolf predation of moose is low.
 - Moose are challenged by a variety of problems that overshadow wolf predation; these include living on the southern end of their range, including habitat, parasites and ticks, bear predation, and potential competition with elk on winter range; challenges are driven by climate and heat stress at the southern end of their range and this can be compounded by climate change. Moose populations in Colorado are doing well.

Interactions on other wildlife species, particularly other large predators and/or other threatened and endangered species

Summary of TWG feedback: Wolves are important components of trophic networks where they are present on the landscape and their presence may have interactions with other large carnivores. The presence of wolves will not have an impact on populations of threatened and endangered species in Colorado, specifically lynx and Gunnison sage grouse.

- Various species benefit from carcasses of prey killed by wolves.
- Abundance and distribution of carrion/carcasses in the winter may benefit wolverines.
- Wolves will kill individual coyotes; Yellowstone data show that coyote populations survive but may change their pack dynamics and behaviors.
- Wolves, lions, and bears may interact and cause some limited mortality for each other.
- Wolf kill rates may decrease in the presence of grizzly bears (not present in Colorado); grizzly bears are dominant on wolf kill carcasses in summer and wolves will stick with carcasses thus reducing kill rates.
- The effects of wolves on lion populations are variable. Northern Yellowstone research did not find a population effect of wolves on lions. Lions may move down in elevation in the absence of wolves. Mountain lion kill rates may increase in presence of wolves because wolves are dominant to lions on carcasses, and lions may increase their kill rates as a result.
- Wolves will eat beavers; in the Great Lakes states, beaver can represent half of wolf diets and 30% of biomass consumed: however, there is generally not a population effect on beavers. Wolf predation of beavers is potentially more opportunistic than bear predation of beavers.

- There is no reason to believe that there will be a significant impact of wolves on lynx or the Gunnison Sage-grouse and Greater Sage-grouse.

Management of conflict with humans and domestic pets

Summary of TWG feedback: Attacks by wolves on humans are exceedingly rare; education and outreach for recreationists and other public lands users should include best practices and guidance, including how to differentiate wolves and coyotes. Flexibility to address rare instances of wolf habituation in areas dominated by humans is important.

Wolf attacks on pets are uncommon; education, outreach, and management should be used to proactively prevent conflict. It is important that public messaging emphasizes the risks assumed when domestic and hunting dogs are present in areas with wolves.

- Strong public messaging should emphasize that dogs can be an attractant for wolves, and, although rare, wolves will kill dogs. Recreationists and hunters should all be aware of this risk when taking dogs into wolf country.
- Hunters that use hunting hounds should be aware of wolf presence where they are hunting and factor that into their decisions regarding whether to hunt with dogs in that area. Wolves do kill hunting hounds, particularly those that hunt far away from people.
- Livestock guardian dogs remain an important consideration for conflict minimization; livestock producers with livestock guardian dogs should also be aware of the risk of wolves to dogs. The use of larger livestock guardian dogs to protect against wolves can also have potential impacts for domestic pets and hunting dogs, due to conflicts between the livestock guardian dogs and pets/hunting dogs sharing the same landscape.
- Consideration of recreationists' experience and purpose on the landscape can help inform education.
- There can be issues with mistaken identity: dogs can be misidentified as wolves; recreationists that are shooting coyotes could mistakenly shoot wolves.
- Distinguish between tolerant and habituated wolves:
 - Tolerant wolves may walk through campsites or pass by people. Wolves that become more tolerant of people are more susceptible to poaching and hunting.
 - Wolves may occasionally become habituated. For example, in Yellowstone National Park, wolves may occasionally take human food or items from campsites.
 - Hazing is a key part of the toolkit for managing habituated wolves and is an effective tool used on a case-by-case basis.
 - Effectiveness of hazing is increased when it is implemented early, before wolves become more bold and habituated.
 - Hazing and aversive conditioning can also be challenging for a management agency because of the need to catch the animals consistently in the act of the behavior that you want to discourage.
 - Having hazing available to producers can support early intervention.
 - A phased approach to hazing and habituation could be considered based on population status.
 - There have been two instances in Yellowstone of lethal take for aggressive and habituated wolves.
- Management approaches:

- State and federal law allow take of wolves that are threatening human safety.
- Management of a wolf that kills a pet or hunting dog will depend on the context; it is important for state agencies to have flexibility.
- Flexibility to address other situations such as wolves denning in human-dominated areas with various tools and on a case-by-case basis is recommended. It is difficult to anticipate all scenarios for interactions with humans, recreationists, livestock, other wildlife, etc.
- Well-trained staff that are good at communicating and managing is important.

Wolf monitoring and expectations for stakeholders and public

Summary of TWG feedback: Monitoring and research should be based on restoration and management goals, use a variety of techniques, and be connected to other elements of wolf management, including conflict minimization. While robust monitoring is valuable at early stages of reintroduction, limitations to monitoring will increase with wolf population growth, requiring transition to a population estimate approach. It is important to consider effective messaging and coordination with stakeholders and the general public when communicating monitoring objectives and data; lead with trust and share data on an as-needed basis.

- There is value in collaring every wolf that is reintroduced for monitoring and data collection purposes and to learn from and improve upon for future releases; however, it is important to educate the public and set expectations that not every wolf in Colorado will be collared as the population grows. There is a risk that the public will incorrectly perceive that the agency is failing in its monitoring efforts over time as fewer wolves are collared and monitored.
- It is important to understand that collars tell managers where wolves have been but not where they are present; monitoring cannot necessarily prevent conflict, but it can increase education on wolf behaviors, patterns, and presence in an area. It can also help in educating people on what to look for with respect to livestock conflict minimization.
 - Some non-lethal tools (i.e., radio-activated guard (RAG) boxes) rely on radio collars; there may be interest in collaring for these purposes, aside from collaring for the state monitoring program. RAG boxes can be used to scare wolves away over a short distance. Ideally, they would be used to alert ranchers of wolf presence, particularly in areas of prior depredation.
 - Immediately following a depredation event can also be an effective time to capture and collar wolves.
 - Collar reliability and longevity varies, and GPS collars are less reliable than VHF collars. A combination of collars can support an effective monitoring program.¹
- Monitoring and research programs should be based on the wolf restoration and management goals and objectives.
 - Colorado's downlisting and delisting thresholds provide recovery goals to guide monitoring program design.
 - Population growth rate is an important indicator for recovery goals. It can be informed by abundance monitoring (e.g., minimum counts, population estimations, number of packs), survival monitoring (adult and pup), recruitment (including reproduction and survival, as well as immigration), and distribution (e.g., den locations).

¹ See the November 2021 TWG Restoration Logistics Report, Pages 17-18, for additional discussion of collars.

- Survival monitoring is an indicator of performance rather than population size. Survival is affected by conflict management, including lethal control.
- Monitoring and research program design, costs, and effectiveness are interrelated with the entirety of the wolf program, including conflict management.
 - It is essential for those conducting monitoring and those leading conflict management and depredation investigations to communicate and effectively coordinate with each other. Monitoring approaches and costs should evolve with the wolf population size, from minimum counts and intensive ground (i.e., camera) and aerial monitoring toward population estimates.
 - A wolf reintroduction and management plan should include a research effort to develop a population estimate model beginning in the early stages of reintroduction. Such a model will support a long-term monitoring program that does not rely on intensive capture and collaring as the population size grows.
- Monitoring and research are a year-round effort involving a variety of techniques to locate and collar wolves.²
 - While a lot of monitoring work can be accomplished from the air and with aerial captures, these techniques are more effective when there are already a lot of collars deployed.
 - A fixed wing pilot with experience locating and tracking uncollared wolves from the air can be an enormous asset in improving the success of helicopter capture efforts.
 - Foothold traps are an important tool for monitoring in other states. Injury rates for foothold traps are low. Use of traps for all wildlife management in Colorado is extremely limited per state Constitution; traps can be used for some conflict mitigation and research purposes.
 - Significant groundwork and scouting are also needed to locate wolves, particularly in early phases of restoration; groundwork increases absent the use of other techniques listed above.
- Adopt an approach to monitoring, information- and data-sharing that leads with trust.
 - Sharing data should be discretionary on an as-needed basis – for example, when working with producers to minimize and manage conflict, or with research partners – rather than a want-to-know basis.
 - Legal implications, including open records laws, should be considered prior to the decision to share data. The statutory and regulatory basis for not sharing data should be made clear to the public.
 - Information-sharing can be general in nature; it does not necessarily need to involve sharing of specific telemetry data or other more sensitive information.
 - Sharing information with the ranching community provides transparency and factual information, can build early trust, and can empower communities to understand the data.
 - This must be balanced against protecting wolves from illegal take; however, there have been positive experiences in other states in sharing monitoring data and locations.
 - Trust is reciprocal; there is risk in sharing information but agencies and ranchers must be able to trust each other.
 - Monitoring activities can also include the public and private property owners.

² See the November 2021 TWG Restoration Logistics Report, Pages 7-10, for additional discussion of capture methods and considerations.

Social and/or economic dimensions wolf management

Summary of TWG feedback: Social and economic dimensions are critical to understand, measure, and incorporate into decisions on wolf management. Perceptions of wolves and perspectives on management vary among people, are generally consistent within interest groups, and often reflect deeply held beliefs and values. There is high potential for social controversy and conflict, particularly as related to expectations and acceptance for use of non-lethal practices, lethal control, recreational harvest/regulated public hunting, and wolf population numbers. Some research suggests that economic benefits can be substantial and much larger than economic costs, however economic benefits and costs are not distributed equally across stakeholders and the public. Consider the breadth of existing social science research, economic indicators, and stakeholder and public feedback when making management decisions, and incorporate new social and economic research into future decisions. Education and outreach can also inform and be informed by social science. It is critical to have trusted, responsive managers on the ground and consistency of management.

- Social and economic dimensions of wolf management consider a variety of stakeholders, interests, and values, for example rural/agricultural and urban.
 - There is high potential for controversy and conflict among different perspectives with respect to wolf restoration and management. There are deeply held, conflicting cultural beliefs or values regarding wolves that are unlikely to change.
 - Social and economic dimensions affect all aspects of wolf management, including restoration, conflict management, compensation and whether and how to approach population management.
 - There is a broad spectrum of perspectives and research to consider specifically in relation to social dimensions of wolf management, social acceptance, and recreational harvest (or, regulated public hunting of wolves). Related to these issues are varying perspectives on ethics and fair chase where regulated public hunting is allowed. These topics will be controversial and contextual; demand, acceptance and/or opposition for harvest will vary by cultures and geographies. Whether allowance or disallowance of recreational harvest/regulated public hunting will change fundamental beliefs is unclear. In addition to being informed by social considerations, allowance or disallowance of regulated public hunting will also be informed by legal considerations including interpretation of authorities relative to the definition of gray wolves in CRS 33-2-105.8 as being a nongame species.
 - There is also high potential for social controversy regarding whether and/or how to set recovery criteria population goals, define self-sustaining populations, and manage populations.
 - Failure to adequately consider different viewpoints can lead to politically driven swings in management.
 - Wolf management and issues in other places, and especially in and around National Parks, affect the national dialogue and state management; management around National Parks involving more national interest groups and polarization can increase the amount of social conflict.
 - Trust in messengers is important; different messengers are effective for different audiences.

- Having responsive, trusted managers on the ground is important for navigating diverse cultures and contexts with respect to wolves.
- Existing and future social and economic science can inform management decisions.
 - Research should be balanced with experiential insights and learning from managers and partners on the ground.
 - Social, economic and biological/ecological research each have the potential to be interpreted to confirm and/or serve different perspectives and positions.
 - Stakeholder representation and leadership in development of the plans increases trust and acceptance; general survey data are not enough.
 - Social/economic indicators (positive and negative) combined with on-the-ground insights can inform future suitability assessments and zonal management by helping to understand patterns of conflict, economic benefits, etc. (see discussion above).
 - A TWG member suggested engaging social scientists and economists to help expand on insights synthesized in this report, including by summarizing public opinion surveys conducted since the early 1990s, research insights from the 2020 Colorado election results on Proposition 114, and other existing literature.
- Social indicators to help inform management could include:
 - Consider the CSU and USDA-APHIS-WS model for habitat suitability/conflict (includes ecological and social data (voting patterns)).
 - Consider ongoing CSU/CPW social science research in Colorado.
 - Behaviors and attitudes in response to wolf presence (for example, adoption of and attitudes toward non-lethal conflict minimization practices and/or compensation, or evidence of poaching or illegal take).
 - Perceptions and values. Consider examples of research from the Northern Rockies. For example, in Montana, social science research has been conducted in 2012 and 2017 and is scheduled to be repeated in 2022; it initially included surveys of big game license holders, wolf license holders, landowners and wolf advocates, and then became a general household survey. It included general wolf acceptance questions and questions on tolerance of specific management actions (reactive to what was done); managers noted that information collected from such surveys can be informative to management but does not necessarily help with the issue of building trust.
- Economic indicators to help inform management could include:
 - Impacts from any changes (if applicable) in ungulate harvest management correlating with wolf restoration, with consideration of pre- and post-restoration license sales as well as the relationship between hunting license sales and outfitting and ranching economics.
 - Positive economic consequences (for example, for the outdoor industry, reduced vehicle collisions, etc.).
 - Economic costs to producers of direct and indirect losses, non-lethal and lethal management, and funding availability for management.
 - Economic costs to agencies (management, compensation, education/outreach, additional staffing, resources, etc.).
 - If there is a net economic benefit, consider how, if possible, it can be quantified and directed toward where the costs are incurred.
 - Economic assessments, particularly those that demonstrate significant positive benefits of wolf restoration, could also be valuable to inform legislators/legislation and support general assembly funding for wolf management.

Appendix A: About the Technical Working Group

The purpose of the Technical Working Group (TWG) is to review objective, science-based information as well as provide its own knowledge and experience at the state/federal/tribal level to inform the development of the Colorado Wolf Restoration and Management Plan. The TWG is composed of members who bring experience in wolf reintroduction, wolf management, conflict minimization, depredation compensation, and other relevant topics. CPW is responsible for writing the Wolf Restoration and Management Plan. The Parks and Wildlife Commission (PWC) serves as the decision-making body responsible for approving the Wolf Restoration and Management Plan. The TWG serves in an advisory capacity to Colorado Parks and Wildlife, offering non-binding input into the development of plan content. The TWG is not a decision-making body and has no authority on wolf management policy, research, or operations. The TWG operates by consensus. For purposes of the TWG, consensus refers specifically to general agreement, or lack of objection, that an option or alternative has sufficient technical merit to be recommended for consideration by CPW. In the absence of consensus, dissenting views will be documented.

Technical Working Group Members:

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Roblyn Brown	Oregon Department of Fish and Wildlife, Wolf Program Coordinator
Wayne East	Colorado Department of Agriculture, Agricultural/Wildlife Liaison
Justin Gude	Montana Fish Wildlife and Parks, Research and Technical Services Bureau Chief
Jonathan Houck	Gunnison County Commissioner
Merrit Linke	Grand County Commissioner
Steve Lohr	U.S. Forest Service, Rocky Mountain Region Renewable Resources Director
Carter Niemeyer	U.S. Fish and Wildlife Service, Retired
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Mike Phillips	Rocky Mountain Wolf Project, Founder/ Turner Endangered Species Fund, Executive Director
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