FINAL ENVIRONMENTAL ASSESSMENT

PREDATOR DAMAGE MANAGEMENT IN COLORADO

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

APRIL 2018

in cooperation with:

Colorado Department of Agriculture
Colorado Parks and Wildlife
Bureau of Land Management
U.S. Forest Service

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List of Acronyms Used

ADM	Animal Damage Management Plan
APHIS	United States Department of Agriculture, Animal and Plant Health Inspection Service
APHIS-WS	APHIS, Wildlife Services
ATV	All-Terrain Vehicle
AVMA	American Veterinary Medical Association
BACI	Before/After-Control/Impact (study design)
BLM	US Department of Interior, Bureau of Land Management
BMP	Best management practice
BO	Biological Opinion
BOR	Bureau of Reclamation
CDA	Colorado Department of Agriculture
CDC	Centers for Disease Control and Prevention
CDE	Carbon Dioxide Equivalent (greenhouse gas metric)
CDFW	California Department of Fish and Wildlife
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CPW	Colorado Parks and Wildlife
CVM	Contingent Valuation Method (economic metric)
CWD	Chronic Wasting Disease
DAU	Data Analysis Unit (Colorado Parks and Wildlife)
dB or dBA	Decibels or A-weighted decibels (metric for sound)
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FY	Fiscal year
GAO	US Government Accountability Office
GHG	Greenhouse gas
GMUG	Grand Mesa, Uncompahgre, and Gunnison (National Forests)
IPDM	Integrated Predator Damage Management OR Integrated Pest Damage Management
IRS	Internal Revenue Service
IWDM	Integrated wildlife damage management
MBTA	Migratory Bird Treaty Act
MIS	USDA-APHIS-Wildlife Services' Management Information System database
MOA	Military Operations Area
MOU	Memorandum of Understanding
MT	Metric Ton
MUSYA	Multiple Use Sustained Yield Act
NASS	USDA-National Agriculture Statistics Service

NED	National Economic Development
NEPA	National Environmental Policy Act
NF	National Forest (USDA-US Forest Service)
NG	National Grassland (USDA-US Forest Service)
NPS	National Park Service
NRCS	USDA-Natural Resources Conservation Service
NTSB	National Transportation Safety Board
NWRC	USDA-APHIS-WS National Wildlife Research Center
OIG	USDA Office of Inspector General
OMB	Office of Management and Budget
PDM	Predator damage management
RA	Resource Area (Bureau of Land Management)
RMP	Resource Management Plan (Bureau of Land Management)
SMA	Special Management Area
TCM	Travel-Cost Method (economic metric)
T/E	Threatened and/or Endangered
TWS	The Wildlife Society
USACE	US Army Corps of Engineers
USC	United States Code [Statute]
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United State Fish and Wildlife Service
USGS	United States Geological Survey
WA	Wilderness Area
WDM	Wildlife damage management
WP	Work Plan (USDA-Wildlife Services document)
WS	USDA APHIS-Wildlife Services
WSA	Wilderness Study Area
WS-Colorado	Colorado Program of USDA-APHIS-Wildlife Services
WTP	Willingness to pay [economic metric)

CHAPTER 1. PURPOSE AND NEED

1.1 Introduction

This chapter provides the foundation for understanding:

- why wildlife damage occurs, the practice of wildlife damage management, and predator damage management in particular;
- the effectiveness and cost-effectiveness associated with predator damage management in the United States;
- the statutory authorities and roles of federal and state agencies in managing damage caused by predators in Colorado;
- the reasons why private and commercial entities, tribes, and federal, state, and local government agencies request assistance from Wildlife Services (WS)-Colorado;
- how WS-Colorado cooperates with and assists private and commercial resource owners and federal, tribal, state and local government agencies in managing predator damage;
- the scope of this National Environmental Policy Act (NEPA) document, the rationale for preparing an environmental assessment (EA), program goals, and decisions to be made by WS-Colorado; and
- the public involvement and notification processes used by WS-Colorado for this EA.

Chapter 2 identifies the issues analyzed in detail in this EA and describes the proposed action and alternatives evaluated in detail as required by the Council on Environmental Quality (CEQ) and NEPA regulations [40 CFR 1502.14(a)]. Chapter 2 also discusses other alternatives which are not included in detailed comparative analyses, with rationale for exclusion, which is also required by CEQ and NEPA [40 CFR 1502.14(a)]. Details of the different wildlife damage management (WDM) methodologies are included in Appendix A. Chapter 3 provides the detailed comparative analysis of the direct, indirect, and cumulative impacts of the proposed action and alternatives on the quality of the human environment.

1.2 In Brief, What is this EA About?

Wildlife Services (WS) is a program within the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), which provides professional Federal leadership and expertise to resolve wildlife conflicts in order to help create a balance that allows people and wildlife to coexist.

WS recommends and implements a cohesive integrated wildlife damage management (IWDM) approach, which incorporates biological, economic, environmental, legal and other information into a comprehensive decision-making process. Non-lethal methods are considered first, but responsible and effective WDM sometimes requires lethal control in order to meet the objectives. See Sections 1.7 and 1.8 for information about WDM and IWDM.

The goal of the WS-Colorado predator damage management (PDM) program, as conducted in the current program, is to manage predator damage, threats of damage, and risks to human/pet health and/or safety by responding to all requests for assistance, including technical assistance and/or direct operational assistance, regardless of the source of the request, private or public (Section 1.10.2).

This environmental assessment (EA) evaluates the impacts of four alternative approaches to managing damage caused by predatory wildlife (*i.e.*, PDM) in Colorado, including the continuation of the current program. The purpose of the EA is to assist WS-Colorado in understanding the environmental impacts of these alternatives, in order to make an informed decision regarding responses to future requests for PDM assistance in Colorado, and to determine whether significant environmental impacts would occur under the chosen alternative, which would require the preparation of an Environmental Impact Statement (EIS).

This EA provides sufficient analysis of impacts to determine whether a Finding of No Significant Impact (FONSI) or an EIS is appropriate. The alternatives considered in this EA vary regarding the degree of WS-Colorado involvement in PDM, the degree of technical assistance (advice, information, education, and/or demonstrations) and operational field assistance (active management of offending predators), and the degree of lethal and non-lethal methods used by WS-Colorado. This EA includes an analysis of potential impacts on all land classes, including federal, tribal, state, county, municipal, airports, and private properties in rural, urban and suburban areas.

Table 1-1. Target mammalian predator species included in this Environmental Assessment.

Common Name	Scientific Name	Management Authority
Coyote	*Canis latrans*	CPW[1]
Raccoon	*Procyon lotor*	CPW
Red Fox	*Vulpes vulpes*	CPW
Striped Skunk	*Mephitis mephitis*	CPW
Black Bear	*Ursus americanus*	CPW
Mountain Lion	*Puma concolor*	CPW
Feral Cat	*Felis domesticus*	Local Government
American Badger	*Taxidea taxus*	CPW
Virginia Opossum	*Didelphis virginiana*	CPW
Bobcat	*Lynx rufus*	CPW
Swift Fox	*Vulpes velox*	CPW
Feral Dog	*Canis domesticus*	Local Government
Feral Domestic Ferret	*Mustela putorius furo*	Local Government
Gray Fox	*Urocyon cinereoargenteus*	CPW
W. Spotted Skunk	*Spilogale gracilis*	CPW
Long-tailed Weasel	*Mustela frenata*	CPW
Short-tailed Weasel	*Mustela erminea*	CPW
American Marten	*Martes americana*	CPW
American Mink	*Neovison vison*	CPW
Ringtail	*Bassariscus astutus*	CPW
Gray Wolf	*Canis lupus*	USFWS[2]

[1] CPW, Colorado Parks and Wildlife
[2] USFWS, United States Fish and Wildlife Service

The proposed action (Alternative 1; Section 2.6 and Appendix A), involves WS-Colorado continuing to use of all appropriate PDM methods, used singly or in combination, to resolve damage caused by predator species included in this EA (Table 1-1). This includes non-lethal and lethal methods. Resource owners that are provided direct PDM assistance by WS-Colorado are encouraged to use reasonable and effective non-lethal management strategies and sound husbandry practices, when and where appropriate, to reduce ongoing and future conflict situations. In most situations, non-lethal methods are implemented by the requester. WS-Colorado proposes to continue responding to PDM requests for the protection of livestock;

property; human/pet health and safety; and natural resources; as well as collecting disease data for research.

See Sections 2.6 through 2.9, and Appendix A for details on the four alternatives evaluated in this EA, and Chapter 3 for an analysis of their associated impacts.

1.3 What Species are Included in this EA?

This EA includes the following predator species: coyote, raccoon, red fox, striped skunk, black bear, mountain lion, feral cat, American badger, Virginia opossum, bobcat, swift fox, feral dog, feral domestic ferret, gray fox, western spotted skunk, long-tailed weasel, short-tailed weasel, American marten, American mink, ringtail, and gray wolf (in order of amount of take by WS-Colorado; Table 1-1). All species except for feral free-ranging dog, cats, and ferrets are managed under state law by Colorado Parks and Wildlife (CPW). Feral domestic animals are managed by local jurisdictions.

1.4 What is the Value of Wildlife?

Native wildlife is a valuable natural resource, long enjoyed by the American public for aesthetic, recreational, emotional, psychological, and economic reasons. Native wildlife species, including the predatory mammals included in this EA, are important to healthy ecosystems and to the well-being of humans. For example, wildlife viewing and ecotourism are enjoyed by millions of Americans, and these activities bring considerable income to local economies (USFWS 2017). Millions of Americans also participate in the hunting of wildlife, which also brings considerable income to local economies (USFWS 2017). Many others find emotional and psychological solace just knowing that wildlife exists in nature. These benefits of wildlife to humans are often referred to as "ecosystem services". Native wildlife are also important parts of their ecosystems. The entire field of ecology is dedicated to the study of the inter-relationships of organisms, including wildlife, to their environments. The roles of wildlife are many and varied, and include predators, prey, and scavengers.

1.5 Why Do Wildlife Damage and Risks to Human Health and Safety Occur?

Native wildlife in overabundance, or individual animals that have learned and habituated to use resources supplied by humans, especially food, can lead to conflicts with humans. Introduced, feral, or invasive species may outcompete native species and cause damage to other resources. Wildlife can destroy crops and livestock; damage property and natural resources, including other species valued by humans; and pose serious risks to public and pet health and safety.

Across the United States, wildlife habitat has been substantially changed as human populations expand, and land is used for human needs. The continued and more intensive use of land by humans; introduction of domestic livestock; water resource management; urbanization; and other modern agricultural, cultural, and transportation practices associated with human development have increased the potential for conflict between humans and wildlife.

Human development and growth continue to put pressures on wildlife populations and their use of remaining habitat. Some wildlife species are more adaptable than others, and this can result in unnaturally high populations of adaptable species, and population reductions in less adaptable species. Some species may adapt to change by using human infrastructure or concentrated agricultural practices for their life cycle needs (food, water, and shelter). Because humans tend to concentrate livestock, food crops, buildings, their pets, and even themselves in localized areas of intensive use, some wildlife species may find it easier to meet their life needs using human-subsidized assets.

Many people move from urbanized areas into rural or newly developed areas, which can create conflicts with existing wildlife. Some individual animals can become habituated to the point that they lose their natural fear of humans, choosing to live near residences, prey on pets and livestock, and/or attack or intimidate people.

Wildlife may serve as reservoirs for diseases and parasites. Wildlife living near areas of human activity may transmit those diseases to livestock, people, and/or pets. These diseases may be transmitted to people directly, such as through physical contact, or indirectly, such as through insect vectors or environmental contamination.

1.6 How Do People Feel About Wildlife?

Schwartz *et al.* (2003) summarize how human attitudes towards large carnivores has evolved over time in Europe and North America from threats to life and property to utilitarian considerations, to valuing their intrinsic values.

Human perceptions, attitudes, and emotions differ depending on how humans desire to "use" different wildlife species and how they interact with individual or groups of animals. For example, seeing a group of deer in a field at dusk may be seen as a positive experience, whereas seeing the same group of deer feeding in your garden or commercial alfalfa field may be frustrating. Similarly, watching a coyote feeding on rodents in the snow may be exciting, whereas having the same coyote eat your pets or farm animals may be highly undesirable and even frightening. Raccoons in the neighboring forest patch may be enjoyable to watch, whereas the same raccoon in your garbage, henhouse, or attic may be intolerable.

We also have cultural perceptions based on our experiences, upbringing, and even childhood stories. Wolves and coyotes may be considered as "bad" because they kill and eat animals we like or because they scare us, but also "good" because they look and behave like our own canine pets, and symbolize "the ecological wild." Some people spend substantial amounts of money to travel to see wildlife in their native habitats or even in zoos, while other people may spend equally substantial amounts of money to have animals removed or harassed away from their neighborhoods, livestock, crops, airports, and even recreational areas where the animals may cause damage, or people may feel or be threatened. Some people are even happy just to know that certain types of animals still exist somewhere, even if they never have the opportunity to see them; they believe that their existence shows that areas of America are still "wild." People will also expect wild animals to be removed or killed when they cause damage to property, economic security, or threaten human safety.

The values that people hold regarding wild animals differ based on their past and day-to-day experiences, as well as the values held by people they trust. For example, people who live in rural areas that depend on land and natural resources tend to consider wildlife from a more utilitarian viewpoint, such as for hunting. Age and gender also influence viewpoints, with younger people and females tending to feel more emotional towards wildlife (Kellert 1994; Kellert and Smith 2000; Table 1-2):

As summarized by Lute and Attari (2016), people have strong opinions about killing wildlife, which are influenced by a myriad of factors, including social identity, experience, and knowledge of the species. Determining whether an individual animal has intrinsic value (inherent value beyond its use to anyone else) is a predictor of support for conservation.

Each person's view of a particular wildlife species is influenced by intrinsic value attributions, morals and morality, economic factors, the practicality with which one views wildlife, cost-benefit analyses, and other objective and subjective characteristics of the species (*e.g.*, attractive, dangerous, endangered, nuisance, important to ecosystems, important to one's well-being). The interactions of how individual people view themselves in relation to the environment, their economic security, the values associated with natural areas and property, and people's needs and desires regarding their relationship with species and individual animals create highly complex attitudes and associated behaviors, including potentially mutually exclusive ones. Also, people may go to great lengths to save an individual identifiable person, but become numb to saving nameless masses ("psychic numbing"). These attitudes can apply to wildlife as well.

Reflecting these tensions in our emotional and physical relationships with wild animals, national policies have changed over time. Policies towards wildlife species that are considered to be desirable because they are hunted, rare, or valued for other reasons have resulted in local, federal, and state governments using taxpayer money to manage those species for their continued existence, increased distribution, and population growth.

Table 1-2. Basic wildlife values. Adapted from Kellert (1994) and Kellert and Smith (2000)**.**

Term	Definition
Aesthetic	Focus on the physical attractiveness and appeal of wild animals
Dominionistic	Focus on the mastery and control of wild animals
Ecologistic	Focus on the interrelationships between wildlife species, natural habitats, humans, and the environment
Humanistic	Focus on emotional affection and attachment to wild animals
Moralistic	Focus on moral and spiritual importance of wild animals
Naturalistic	Focus on direct experience and contact with wild animals
Negativistic	Focus on fear and aversion of wild animals
Scientific	Focus on knowledge and study of wild animals
Utilitarian	Focus on material and practical benefits of wild animals

Lute and Attari (2016) recognize that conflicts with wildlife have been ongoing, especially as humans have made and continue to make substantial modifications to the environment and land uses that have created such conflicts, and that lethal control may be more cost-effective than sweeping habitat protection strategies. Their study suggests that people may rely on default strategies such as habitat and ecosystem protection and moral considerations rather than also considering economic and social costs necessary for navigating difficult trade-offs and nuances inherent to decision-making in wildlife management.

Trade-offs can and do occur between conservation objectives and human livelihoods (McShane *et al.* 2011). These authors argue that many options exist in managing wildlife conflict in relation to protection of individual animals, populations, ecosystems, and human physical and economic well-being, and that these choices are "hard" because every choice involves some level of loss that, for at least some of those effected, is likely to be significant.

1.7 At What Point Do People or Entities Request Help with Managing Wildlife Damage?

As a society, our attitudes have changed over time, and now those same species seen as conflicting with human values may be considered desirable, but even then, only under socially-acceptable circumstances. The tension regarding the use of public funds and/or lands to support a wide variety of private/individual uses or incomes (not only related to wildlife) is a federal and/or state governmental policy consideration. An example of this tension can involve livestock producers who lease public lands for grazing, and those who oppose grazing on public lands. Another example can occur between the same livestock producers attempting to limit losses through lethal PDM, and those who believe that livestock losses should be considered a "cost of doing business", especially on public lands.

When individual animals cause damage to property, agriculture, economic security, threaten the sustainability of managed or protected wildlife species, and/or threaten human and pet health and safety, there are many situations when people, government agencies, or commercial interests request private companies or federal or state governments to remove, kill, or disperse the animals or groups of animals causing the problems. When damage or losses have previously occurred and can be expected to occur again, people or agencies may request that animals or groups of animals be removed or dispersed to avoid further losses, even before the damage or losses reoccur. Without outside help, people or entities will often try to resolve the problems themselves, using non-lethal and lethal methods, including traps, firearms, and toxic chemicals. Unfortunately, the animals killed by these people and entities may or may not be causing the problem, and the methods might be dangerous, illegal, environmentally damaging, and/or biologically un-sound.

The term "damage" in the case of WDM may be defined as economic losses to property or assets, or threats to human or pet safety. However, "damage" may also be defined as a loss in the aesthetic value of property and other situations where the behavior of wildlife is no longer tolerable to an individual person or entity.

People and entities concerned about future damage may also respond to the "threat" of damage, before any damage has occurred. In situations where damage would be reasonably expected to occur, such responses are prudent. However, in other situations, such responses may not be warranted.

The threshold triggering a request for assistance in dealing with a particular damage situation is often unique to the individual person, entity, or agency requesting assistance. Therefore, what constitutes intolerable damage to one person or entity may not be considered a problem by another individual or entity.

Addressing wildlife damage problems requires consideration of both the resource owners' and society's levels of acceptability and tolerance, as well as the ability of ecosystems and local wildlife populations to absorb change without long-term or short-term adverse impacts.

"Biological carrying capacity," as we use it here, is the maximum number of animals of a given species that can, in a given ecosystem, survive through the least favorable conditions occurring within a stated time interval. In other words, it is the largest number of animals that can sustainably survive under the most restricting ecological conditions, such as during severe winters or droughts (The Wildlife Society 1980). Biological carrying capacity is generally simply referred to as "carrying capacity".

The "wildlife acceptance capacity," or "cultural carrying capacity," is the limit of human tolerance for wildlife or its behavior and the number of a given species that can coexist compatibly with local human populations. Just the presence of a wild animal may be considered threatening or a nuisance to people with low tolerance or inexperience with wild animals, or when the animals are viewed as cruel, aggressive, or frightening. Those phenomena are especially important because they define the sensitivity of a person or community to coexisting with a wildlife species.

Whereas the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the cultural carrying capacity is lower. When the cultural carrying capacity is met or exceeded in a particular circumstance, people take action or request assistance to alleviate the damage or address threats of damage.

1.8 What is Wildlife Damage Management?

In many cases, wildlife management agencies endeavor to affect the overall or regional population of a wildlife species, such as managing for an increase in the population of an endangered species or a popular game species. This is generally referred to as "wildlife management".

Wildlife Damage Management (WDM), on the other hand, focuses on addressing a specific damage situation, not broad-scale population management. In general, the goal of WDM is to alleviate the damage, without affecting overall or regional populations. The Wildlife Society, a non-profit scientific and educational association which represents wildlife professionals, recognizes WDM as a specialized field within the wildlife profession, and espouses adherence to professional standards for responsible WDM. Their official position on WDM is as follows (The Wildlife Society 2017):

"Wildlife sometimes causes significant damage to private and public property, other wildlife, habitats, agricultural crops, livestock, forests, pastures, and urban and rural structures. Some species may threaten human health and safety or be a nuisance. Prevention of control of wildlife damage, which often includes removal of the animals responsible for the damage, is an essential and responsible part of wildlife management. Before wildlife damage management programs are undertaken, careful assessment should be made of the problem, including the impact to individuals, the community, and other wildlife species. Selected techniques should be incorporated that will be efficacious, biologically selective, and socially appropriate."

The Wildlife Society further "recognize[s] that wildlife damage management is an important part of modern wildlife management" (The Wildlife Society 2017).

In the past, as settlers moved across the West, large predators such as bears, wolves, and cougars were perceived as inherent threats to safety and food supply. These species were feared, and humans systematically extirpated or substantially reduced their population sizes in many areas through overhunting, government and private predator removal programs, and/or habitat destruction. The goal of these programs was to decrease or eliminate the populations of wildlife perceived as a threat. But with new science and changing societal values, governmental policies have changed. Taxpayer funds that were once used to directly reduce "undesirable" wildlife predator populations, such as wolves or grizzly bears, may now be used to protect and increase their populations and habitats. Moreover, the focus on damaging wildlife species has largely shifted from population control (wildlife management), to focus more on alleviating the damage they cause (WDM).

1.9 What is Integrated Wildlife Damage Management?

In addressing conflicts between wildlife and people, consideration must be given not only to the needs of those directly affected by wildlife damage, but also to a range of environmental, sociocultural, economic, and other relevant factors. To accomplish this, an integrated approach is often applied, in which a combination of methods may be used or recommended to alleviate the conflict. The challenge is to develop strategies that include the most effective combination of techniques using sustainable methods that balance these considerations. This approach is generally referred to as "integrated" wildlife damage management (IWDM).

Adapting the definition of Integrated Pest Management from the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA; 40 CFR 152) to WDM, IWDM involves considering and applying options, tools, and techniques, either singly or in combination, for resolving the damage or threat of damage using a strategy that is sustainable and appropriate to the specific project circumstances in a way that minimizes economic, health, and environmental risks.

An additional benefit of this integrated approach (IWMD) is that the use of a variety of techniques improves efficacy. There are two reasons for this:

(1) Different techniques may be more or less effective, depending on the specific circumstances.

(2) Combinations of techniques often have a synergistic effect; the combination works better than the sum of the individual techniques.

1.10 What are Predator Damage Management and Integrated Predator Damage Management?

Managing damage caused by wildlife species identified as "predators" is known as predator damage management (PDM). PDM generally refers only to mammalian predator species, and excludes predatory bird species like raptors. When an integrated approach to PDM is used, it is often referred to as "integrated predator damage management". For WS-Colorado, this distinction is purely academic, because the only predator damage management practiced by WS-Colorado uses the integrated approach. Therefore, when we refer to PDM, we are intuitively referring to "integrated predator damage management". Throughout this EA, we will use the abbreviation "PDM" to refer to integrated predator damage management. This also helps distinguish integrated *predator* damage management (herein, PDM) from integrated *pest* damage management (IPDM), which includes the management of damaging insect pests.

Henceforth, all references to PDM in this document refer to integrated predator damage management.

1.11 What Are the Roles of USDA APHIS Wildlife Services in WDM and PDM?

APHIS-WS provides federal professional leadership and expertise to resolve wildlife conflicts to help create a balance that allows people and wildlife to coexist. APHIS-WS applies and recommends a cohesive integrated approach, IWDM, which incorporates biological, economic, environmental, legal and other information into a transparent WDM decision-making process, and includes many methods for managing wildlife damage, including nonlethal and lethal options (APHIS-WS Directive 2.105).

Per APHIS-WS Directives 2.101 and 2.105, when selecting and applying a particular method or methods, "consideration must be given to the species responsible and the frequency, extent, and magnitude of damage. In addition to damage confirmation and assessment, consideration must be given to the status of target and potential non-target species, local environmental conditions, relative costs of applying management techniques, environmental impacts, and social and legal concerns."

The APHIS-WS mission is broad, and includes resolution of wildlife conflicts in rural and urban areas; conservation of natural resources (including threatened and endangered species, and managed wildlife populations); protection of public, private, and commercial property and assets; and control of invasive species and wildlife disease vectors. Increasingly, APHIS-WS is responsible for minimizing wildlife threats to public health and safety, as well as to the nation's vital agricultural base.

APHIS-WS relies on a paired program of fieldwork (operations) and research. Its National Wildlife Research Center (NWRC), internationally recognized as a leader in WDM science, conducts research and develops tools to address dynamic WDM challenges. APHIS-WS operations personnel and NWRC researchers work closely together to ensure that APHIS-WS will continue to resolve wildlife conflicts effectively, and as humanely as possible, using advanced science and technology. The NWRC applies scientific expertise to the development of practical methods to resolve these problems, and to maintain the quality of the environments shared with wildlife. The Center designs studies to ensure that the methods developed to alleviate animal damage are safe, effective, biologically sound, economical, and acceptable to the public. NWRC scientists produce and test the appropriate methods, technology, and materials for reducing animal damage. Through the publication of results and the exchange of technical information, the

NWRC provides valuable data and expertise to the public and the scientific community, as well as to APHIS-WS' operational program.

1.11.1 What is the Federal Law Authorizing Wildlife Services' Actions?

APHIS-WS is the federal agency authorized by Congress to protect American resources from damage associated with wildlife. This authority is provided by The Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 8351), commonly referred to as the Animal Damage Control Act. This Act states:

"The Secretary of Agriculture may conduct a program of wildlife services with respect to injurious animal species and take any action the Secretary considers necessary in conducting the program…."

The [Animal Damage Control] Act was amended in 1987 (Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. 8353) to further provide:

"On or after December 22, 1987, the Secretary of Agriculture is authorized, except for urban rodent control, to conduct activities and to enter into agreements with State, local jurisdictions, individuals, and public and private agencies, organizations, and institutions in the control of nuisance mammals and birds and those mammal and bird species that are reservoirs for zoonotic diseases, and to deposit any money collected under such agreement into the appropriation accounts that incur the costs to be available immediately and to remain available until expended for Animal Damage Control activities."

1.11.2 What Are the Mission, Goals, and Objectives of APHIS-WS and WS-Colorado?

APHIS-WS' mission is to provide federal leadership and expertise to resolve wildlife conflicts to allow people and wildlife to coexist (WS 2017b). The agency is funded by Congressional appropriations and by funds provided by governmental, commercial, private, and other entities that enter into an agreement with APHIS-WS for assistance. In Colorado, IWDM activities are funded by Congressional appropriations (about 34%); federal interagency agreements (about 21%); and state and local government, and private, commercial, or other cooperators (about 45%). Cooperators are always responsible for contributing a proportion of the costs of operational management, including WS-Colorado administrative overhead.

To facilitate long-term strategic planning, APHIS-WS identified a list of core program functions in the APHIS-WS 2013-2017 Strategic Plan (WS 2013b), including these functions relevant to WS-Colorado:

- Predation management for the protection of wildlife
- Protection of natural resources (including threatened and endangered species) from other injurious wildlife
- Protection of agricultural resources and property from wildlife damage
- Airport wildlife hazard management
- Conducting wildlife damage research

APHIS-WS responds to requests for assistance from private and public entities, tribes and other federal, state, and local governmental agencies (APHIS-WS Directive 1.201 and 3.101).

The APHIS-WS program carries out its federal mission for helping to solve problems that occur when human activity and wildlife are in conflict with one another through:

- Providing training to governmental and commercial WDM professionals when requested;
- Developing and improving strategies to reduce economic losses and threats to humans from wildlife;

- Collecting, evaluating, and disseminating information on WDM techniques;
- Responding to requests for assistance with WDM situations, including providing technical advice and a source for loaned, limited-use management materials and equipment such as cage traps and pyrotechnics; informing and educating the public and cooperators on how to avoid or reduce wildlife damage; and/or addressing the problem through direct action.

The **goal of WS-Colorado** is to respond in a timely and appropriate way to all requests for assistance. Responses, whether over the phone, remotely, or in the field, follow a formal decision process (APHIS-WS Decision Model, APHIS-WS Directive 2.201, Section 2.6.2) to evaluate, formulate, and implement or recommend the most effective strategy. The recommended strategy is designed to reduce or eliminate damage and risks caused by the offending animal(s) to resolve conflicts with humans and their valued resources, health, and safety, without negatively impacting the environment. These strategies may be both short term and long term, are often a combination of methodologies, and are based on APHIS-WS' mission of professionally supporting the coexistence of humans and wildlife.

In regard to predators and PDM, the **WS-Colorado objectives** are to:

- Professionally and proficiently respond to all reported and verified losses or threats due to predators using the PDM approach using the APHIS-WS decision model (APHIS-WS Directive 2.201; Section 2.6.2). PDM must be consistent with all applicable federal, state, and local laws, APHIS-WS policies and directives, cooperative agreements, MOUs, and other requirements as provided in any decision resulting from this EA.
- Solve predator damage problems using integrated PDM methods, with success determined by amelioration or elimination of damage or threats of damage.
- Implement PDM so that cumulative effects do not negatively affect the viability of any native predator populations.
- Ensure that actions conducted within the PDM strategy fall within the management goals and objectives of applicable WDM plans or guidance as determined by the jurisdictional state, tribal, or federal wildlife management agency.
- Minimize non-target effects by using the APHIS-WS Decision Model (APHIS-WS Directive 2.201; Section 2.6.2) to select the most effective, target-specific, and humane remedies available, given legal, environmental, and other constraints.
- Incorporate the use of appropriate and effective new and existing lethal and non-lethal technologies, where appropriate, into technical and direct assistance strategies.

APHIS-WS' activities are conducted in accordance with applicable federal, state, and local laws, Work Initiation Documents, cooperative agreements, Memoranda of Understanding (MOU), and other applicable agreements and requirements, and the directives found in the WS Program Policy Manual (WS 2016c). These documents establish the need for requested work, legal authorities allowing the requested work, and the respective responsibilities of APHIS-WS and its cooperators.

1.11.3 How Does APHIS-WS Ensure the Implementation of Professional WDM Practices?

Each APHIS-WS state office carries out the APHIS-WS mission in accordance with the differing management goals of its state. WDM activities can include providing assistance with WDM for the purposes of managing property and asset damage and losses, protecting special status wildlife, reducing or eliminating invasive species, protecting human health or safety, conducting research, and managing diseases which can be passed among wildlife, or from wildlife to people or domestic animals.

Per APHIS-WS policy and practice, APHIS-WS State Directors and District Supervisors are professional wildlife biologists. Supervisors oversee teams of highly trained and specialized wildlife biologists, wildlife specialists, and other field personnel.

APHIS-WS field personnel must be experienced in wildlife management and ecological principles and practices, and highly competent in identifying predator sign, field skills, and developing and implementing effective strategies within a wide diversity of challenging conditions and circumstances. They are highly trained in the use of firearms, capture techniques, pyrotechnics, field chemicals, and other methods described in detail in Appendix A per APHIS-WS Directives. They must also be experienced in working with people, and in using clear strategic skills in applying their experience, expertise, and training in applying the APHIS-WS Decision Model in effective and creative ways (Section 2.6.2).

The WS Code of Ethics, Directive 1.301, states: "WS is the Federal leader in providing wildlife damage management solutions that are safe, effective, selective, economically feasible, and environmentally responsible…Our individual and collective adherence to this Code of Ethics will promote public service and will uphold the standards of the WS program."

Employee characteristics identified in this Code of Ethics include commitment to compliance with legal requirements; honesty; integrity; accountability; continual learning and professional development; showing high levels of respect for people, property, wildlife, and varying viewpoints regarding wildlife and wildlife management; conservation of natural resources; using the most selective and humane methods available, with preference given to non-lethal methods when practical and effective; using the APHIS-WS Decision Model to resolve WDM problems; providing expertise on managing wildlife damage to the public upon request; and working in a safe and responsible manner.

All field personnel, as needed and appropriate, are trained, with periodic refreshers, in:

- The safe and proficient use of firearms (WS Directive 2.615);
- The safe involvement in aerial operations (WS Directives 2.620 and 2.305);
- The safe and proficient use of explosives and pyrotechnics (WS Directive 2.625);
- The safe use and management of hazardous materials (WS Directive 2.465);
- The safe and compliant use of pesticides (WS Directive 2.401);
- The safe and proficient use of M-44s (WS Directive 2.415); and
- The safe and humane use of immobilizing and euthanizing drugs (WS Directive 2.430).

1.11.4 How Does APHIS-WS Operate?

APHIS-WS personnel respond to requests for assistance by reviewing the circumstances to determine whether wildlife caused the problem, and if so, identifying which species of wildlife caused the problem, and then recommending one or more courses of action to minimize the risk of further damage (APHIS-WS Directive 2.201). This first type of action is called "technical assistance" wherein APHIS-WS personnel recommend actions that can be implemented by the resource owner or manager, such as better fencing, closer husbandry of livestock, or removing the offending animal themselves compliant with applicable laws.

APHIS-WS field personnel may also take action directly in response to a request for assistance, called "direct assistance" activities. These actions can include non-lethal techniques such as harassment and/or lethal measures that remove the offending animal(s), such as capturing them with specialized equipment and conducting euthanasia when needed. The actions can occur in urban or field settings, including secured and limited use areas such as military bases and airports. Before WDM of any type is conducted, a Work Initiation Document must be signed by a representative of WS-Colorado and the land owner or manager, or, for work on federal lands, a Work Plan is discussed and agreed upon by the land management administrator or agency representative and WS-Colorado. For most federal lands, this Work Plan is the Animal Damage Management Plan (ADM).

Trained and experienced field personnel determine the appropriate PDM methodologies to recommend and/or implement using the APHIS-WS Decision Model (Slate *et al.* 1992, APHIS-WS Directive 2.201, Section 2.6.2, hereafter called the "Decision Model"). After receiving a request for assistance, field employees use the Decision Model to assess the problem; evaluate the effectiveness of the various methods available; recommend a strategy based on short-term and long-term effectiveness, and possible restrictions, constraints, and environmental considerations and cost; discuss the options with the cooperator; and formulate the strategy. They then provide the appropriate assistance, and the field employee and/or the cooperator monitors the effectiveness of the strategy. The use of the Decision Model is discussed in more detail in Section 2.6.2.

When direct operational assistance is requested, the APHIS-WS employee makes the determination whether or not to participate based on authority, jurisdiction, funding, and a professional determination of the scientific appropriateness and effectiveness of the strategy agreed to by the requester. In some cases, especially if the requester is CPW or USFWS, a specific strategy may be requested. CPW is authorized to control the threat of predator-related damage to wildlife populations under their authority using hunting seasons and administrative removals of predators. The USFWS is authorized to manage Endangered Species Act (ESA)-listed species, migratory birds, and eagles. When CPW or USFWS request PDM assistance for protection or management of species under their jurisdiction, especially if the request involves localized population reduction, WS-Colorado evaluates the potential effectiveness and appropriateness of their involvement before making the decision to assist. For example, WS-Colorado considers whether the proposed actions would occur at the appropriate time of year, and whether the actions are likely to produce the desired results.

WS-Colorado PDM activities are described in detail in Section 2.6 (Alternative 1).

1.12 What Actions Are Outside of APHIS-WS' Authority?

APHIS-WS does not have any authority to manage wildlife other than the authority provided by Congress for assisting with wildlife-caused damage. APHIS-WS policy is to respond to requests for assistance with managing wildlife damage. Managing wildlife populations and even individual wild animals is under the legal jurisdiction of state wildlife agencies, the USFWS for ESA-listed species, the USFWS for migratory birds and eagles, and tribal governments on tribal lands. APHIS-WS defers to these entities and the applicable laws in these cases.

APHIS-WS has no authority to determine the use and/or commitment of local, state, tribal or federal resources or lands, such as for livestock grazing or timber harvest. APHIS-WS also has no authority to determine the use and/or commitment of private land, such as for livestock feedlots, or for development by individuals, corporations, or government entities.

APHIS-WS is not authorized to make public land management decisions. Policies that determine the multiple uses of public lands are based on Congressional acts through laws such as the Taylor Grazing Act of 1934 and the Federal Land Policy and Management Act for the BLM, and the Forest Service; and the Organic Act of 1897 and the Multiple Use-Sustained Yield Act of 1960 for the Forest Service. Congressional appropriations support the implementation of these authorities. WS-Colorado only conducts PDM on public lands upon request of the land management agency, and does not have the authority to determine whether PDM will be conducted (WS Directive 2.201).

WS-Colorado is not authorized to use pesticides unless they are approved by the U.S. Environmental Protection Agency (EPA) per FIFRA, and are registered for use in Colorado. WS-Colorado must ensure that all storage, use, and disposal by WS-Colorado personnel is consistent with FIFRA label requirements and WS Directive 2.401.

APHIS-WS is not authorized to make wildlife management decisions. Each state has full authority and jurisdiction to manage the native wildlife within its boundaries, unless authority is granted to another governmental entity, such as USFWS per the ESA, Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act.

In Colorado, most native mammalian wildlife species are managed by CPW. The USFWS has authority regarding wildlife and plant species listed per the Endangered Species Act (Public Law 93-205, 15 USC 1531 as amended). The State of Colorado has its own list of State-Endangered and State-threatened species, and species of special concern.

The USFWS is also the authority for managing intentional and non-purposeful take of bald and golden eagles through the issuance of permits under the Bald and Golden Eagle Protection Act.

1.13 How Does WS-Colorado Work with CPW, CDA, and Counties?

When assistance is requested from CPW or Colorado Department of Agriculture (CDA) for a predator damage problem, WS-Colorado cooperates with the state agency per applicable Colorado statute and regulations, and in accordance with guidelines, restrictions, and objectives set forth by CPW management and conservation plans, and cooperative agreements. WS-Colorado can act as an agent of CPW, CDA, or a landowner, depending on the entity requesting assistance.

WS-Colorado has Cooperative Service Agreements with CDA and CPW. These documents establish cooperative relationships between WS-Colorado and the state agencies, outline responsibilities and agreements for funding, and set forth objectives and goals for resolving wildlife damage conflicts. Whereas the wording of these Intergovernmental and Cooperative Services Agreements may change upon renewal, it is not expected that future conditions included in the agreements would have environmental relevance not already evaluated in this EA.

WS-Colorado has authority under the Act of 1931 and subsequent amendments allowing for WS-Colorado to enter into agreements with public and private entities.

WS-Colorado policy allows personnel to assist in feral and free-ranging dog control at the request of local authorities upon approval by the State Director. APHIS-WS Directive 2.340, regarding responding to damage caused by feral, free-ranging, and hybrid dogs, states that such actions will be coordinated either for each action or programmatically with state, local, and tribal authority before taking such action, and that each APHIS-WS state office will develop a state-wide policy.

Any state agencies not currently under an intergovernmental agreement with WS-Colorado may enter into one consistent with the analyses and impacts in this EA and APHIS-WS policies and directives, and thereby the activities would be covered by this EA.

1.14 How Does WS-Colorado Work with Federal Agencies?

1.14.1 How Does WS-Colorado Work with the US Forest Service and the BLM?

The United States Forest Service (USFS) and the Bureau of Land Management (BLM) manage federal lands under their jurisdiction for multiple uses, including recreation, wildlife habitat, livestock grazing, energy development, timber production, wilderness, and cultural resources.

Before performing PDM activities on lands under their jurisdiction APHIS-WS coordinates with these land management agencies through work-planning meetings, and the preparation of work plans called Animal Damage Management Plans (ADMs), as required under the Memoranda of Understanding (MOUs) with USFS and BLM (Section 1.14.2). USFS and BLM prepare land management plans per the National Forest Management Act (USFS) and Federal Land Policy and Management Act (BLM) that guide long-range management direction and include action constraints for protecting sensitive resources. These USFS and BLM land management plans include a public involvement and comment process. USFS and BLM ensure that WS-Colorado actions under the ADMs comport with these land management plans, and with policies specific to each USFS National Forest (NF), USFS National Grassland (NG), or BLM District/Field Office. WS-Colorado has been requested to operate on most NFs and BLM Districts within Colorado. Current ADMs involve nine NFs, two NGs, and both BLM Districts for the protection of livestock and/or human safety. All NFs, NGs, and BLM Districts may request WS-Colorado assistance with emergency work at any time.

All PDM which might be conducted under these ADMs is included and analyzed in this EA. The purpose of these ADMs is to coordinate with these land management agencies regarding the implementation of the actions analyzed in this EA. ADMs might include limitations to the PDM analyzed in this EA. For example, an ADM might identify specific methods which will not be used in certain areas, or areas where PDM will generally not be conducted, based on management practices prescribed in land management plans. Work-planning meetings to develop these ADMs are generally conducted annually. ADMs from prior years may be adopted without a work-planning meeting when the agencies determine that no change to the existing ADM is warranted, or when no work is expected to be conducted on those lands. Whether PDM might be conducted in Special Management Areas (SMAs), including Wilderness Areas (WAs), and Wilderness Study Areas (WSAs), is included in these ADMs. ADMs might include maps of USFS or BLM lands depicting the locations where limitations on WDM are to be incorporated, or where PDM is authorized. These maps are generally extremely large in size (*e.g.*, 6' by 8'), and subject to change in future ADMs. These maps are stored in the local WS-Colorado District Office, and are available to appropriate WS-Colorado employees, for the timeframe they are in effect. Neither the ADMs nor the maps associated with them include any PDM method, species, or action outside of the analysis in this EA.

For this EA, the USFS and BLM are cooperating agencies and have been involved with this EA to ensure consistency with their land management plans. In Colorado, National Forests (NFs) and National Grasslands (NGs) include:

- Arapaho NF
- Grand Mesa NF
- Gunnison NF
- Pike NF
- Rio Grande NF
- Roosevelt NF
- Routt NF
- San Isabel NF
- Uncompahgre NF
- White River NF
- Comanche NG

- Pawnee NG

BLM has two districts in Colorado, encompassing seven Field Offices, and one Heritage Center, one National Monument, and three National Conservation Areas. Most of these have their own Resource Management Plans (RMPs):

- Northwest District
  - Colorado River Valley Field Office
  - Kremmling Field Office
  - Little Snake Field Office
  - White River Field Office
- Southwest District
  - Tres Rios Field Office
  - Uncompahgre Field Office
  - Grand Junction Field Office
  - Anasazi Heritage Center/Canyons of the Ancients National Monument
  - Gunnison Gorge National Conservation Area
  - Dominguez-Escalante National Conservation Area
  - McInnis Canyons National Conservation Area

1.14.2 What MOUs Does APHIS-WS Have with the US Forest Service and BLM?

APHIS-WS has memoranda of understanding (MOUs) with the USFS and the BLM for PDM work on federal lands and resources under their jurisdiction.

1.14.2.1 MOU with the U.S. Forest Service:

Documents the cooperation between the USFS and APHIS-WS for managing indigenous and feral vertebrates causing resource damage on USFS lands, minimizing livestock losses due to predation by coyotes, mountain lions, black bears and other predators, managing wildlife diseases, managing invasive species, and protecting other wildlife, plants, and habitat from damage as requested by the Forest Service and/or state or Federal wildlife management agencies.

APHIS-WS evaluates needs for PDM in cooperation with the USFS, develops and updates ADMs in cooperation with the USFS and appropriate state and federal agencies, tribes, and others. USFS cooperates with APHIS-WS to ensure that planned PDM activities do not conflict with other land uses, including human safety zones, and to ensure that ADMs are consistent with forest plans. APHIS-WS notifies the USFS before conducting activities on NFS lands and provides reporting on PDM results.

APHIS-WS is responsible for NEPA compliance for wildlife damage, invasive, and wildlife disease management activities when requested by entities other than the USFS, and coordinates with the USFS, relevant state and federal agencies and tribes in completing NEPA compliance; the USFS complies with NEPA for all actions initiated by the USFS.

APHIS-WS provides technical assistance and training to the USFS on WDM methodologies when requested.

USFS is responsible for conducting minimum requirements analyses to measure impacts of PDM activities in wilderness areas and wilderness study areas.

1.14.2.2 MOU with the BLM:

- Documents cooperation with BLM, APHIS-WS, and state governments, provides guidelines for field operations, and identifies responsibility for NEPA compliance for PDM activities regarding predation by native and feral animals on livestock and wildlife, including federally-listed threatened and endangered species, and to other resources and human health and safety, consistent with multiple-use values.
- APHIS-WS and BLM cooperate to identify areas on BLM lands where mitigation or restrictions may apply, including human health and safety zones; the development and annual review of PDM plans on BLM resources, consistent with the Federal Land Policy and Management Act, land and resource management plans, and federal laws; and evaluate needs for PDM in cooperation with state agencies, grazing permittees, adjacent landowners, and any other resource owner or manager, as appropriate.
- APHIS-WS is responsible for NEPA compliance for predator and invasive species damage and wildlife disease management activities conducted in response to requests on BLM lands, and will coordinate with and report to the BLM and state and local agencies and tribes during compliance.
- APHIS-WS will notify the BLM about the results of actions taken on BLM lands in an annual report.
- BLM is responsible for conducting minimum requirements analyses to measure impacts of PDM activities in wilderness areas and wilderness study areas.

1.14.3 How Does WS-Colorado Work with the US Fish and Wildlife Service?

When WDM activities may affect federally listed threatened or endangered species, WS-Colorado consults with the US Fish and Wildlife Service (USFWS) to ensure its program will not jeopardize the continued existence of the listed species. Under Section 7 of the ESA, Federal agencies must consult with the USFWS when any action the agency carries out, funds, or authorizes may affect a listed endangered or threatened species. Potential effects of WS-Colorado activities on federally listed species in Colorado were evaluated by WS-Colorado in a Biological Assessment (dated July 29, 2016; Appendix C). Mitigation measures to decrease the likelihood of impacts were included in this assessment. The USFWS responded with a Biological Opinion (dated November 18, 2016; Appendix D), which concurred with WS-Colorado's assessments, and mitigation measures. WS-Colorado closely follows these mitigation measures outlined in its ESA consultation documents in order to minimize the risk of take of listed species. WS-Colorado may also assist the USFWS in protecting ESA-listed species, when requested.

Potential impacts of the WS-Colorado PDM program on threatened and endangered species is analyzed in Section 3.2.1.

APHIS-WS has a national Memorandum of Understanding with the US Fish and Wildlife Service, including the following pertinent sections:

- APHIS-WS and the USFWS recognize that non-target migratory birds might incidentally be killed despite the implementation of all reasonable measures to minimize the likelihood of take during actions covered under depredation permits, depredation and control orders, and agricultural control and eradication actions.

- During NEPA compliance, APHIS-WS will evaluate the reasonable range of alternatives, assess and estimate impacts on migratory birds, monitor migratory birds with other collaborators (as funds allow), and consider impacts on target and non-target species and ways to minimize impacts.
- USFWS will provide APHIS-WS available migratory bird population data, reported take by non-APHIS-WS entities, and biological information as requested within a reasonable time frame.

1.14.4 How Does WS-Colorado Work with the FAA and NASAO?

WS-Colorado works with the Federal Aviation Administration (FAA) and National Association of State Aviation Officials (NASAO), when requested, for necessary resolution of wildlife damage manage at airports to support aviation safety.

1.14.4.1 APHIS-WS MOU with the FAA and the National Association of State Aviation Officials:

- This partnership supports the organizations' common mission to collaboratively advance and encourage aviation safety within their respective areas of responsibility and to reduce wildlife hazard risks through education, research, and outreach, including promoting effective communication for ensuring critical safety, security, efficiency and natural resources/environmental compatibility.
- The end goal is to increase wildlife strike reporting and technical and operational assistance and necessary training to the aviation community to ultimately reduce the risk of wildlife hazards and ensure safer operations at airports.

1.15 How Does WS-Colorado Comply with NEPA?

1.15.1 How Does NEPA Apply to WS-Colorado's PDM Activities?

The National Environmental Policy Act, as amended (NEPA; Public Law 9-190; 42 U.S.C. 4321 *et seq*.), and as interpreted by the CEQ, requires that federal actions be evaluated in terms of:

- Their potential to significantly affect the quality of the human environment for the purpose of avoiding or, where possible, mitigating and minimizing adverse impacts;
- Making informed decisions; and
- Including agencies and the public in their planning in support of informed decision-making.

WS-Colorado WDM activities, including PDM, are federal actions, and are thus subject to NEPA. WS-Colorado follows NEPA, as well as CEQ regulations on implementing NEPA (40 CFR 1500 et seq.), and USDA (7 CFR 1b) and APHIS (7 CFR 372) Implementing Procedures, as part of the decision-making process.

The analysis contained in this EA is based on information and data derived from APHIS-WS' Management Information System (MIS) database; data from the CDA and CPW regarding species under their jurisdiction; published and, when available, peer-reviewed scientific documents; interagency consultations; public involvement; and other relevant sources. This EA uses the best available information from these and other sources to conduct informed analyses suitable for decision-making.

To assist with understanding applicable issues and reasonable alternatives to managing predator damage in Colorado and to ensure that the analysis is complete for informed decision-making, WS-

Colorado has made this EA available to the public, agencies, tribes and other interested or affected entities for review and comment prior to making and publishing the decision (either preparation of a FONSI or a Notice of Intent to prepare an EIS). Public outreach notification methods for an EA include postings on the national APHIS-WS NEPA webpage (https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/programs/nepa/ct_nepa_regulations_assessments) and on www.regulations.gov, a direct mailing to known local stakeholders, electronic notification to registered stakeholders on www.GovDelivery.com, and notification in the legal section of newspapers such as *The Denver Post*. The public will be informed of the decision using the same venues, including direct mailed notices to all individuals who submit comments and provide physical addresses.

WDM is a complex issue requiring coordination among state and federal agencies and the tribes. To facilitate planning, efficiently use agency expertise, and promote interagency coordination with meeting the needs for action, WS-Colorado is coordinating the preparation of this EA with cooperating and consulting partner agencies, including CPW, CDA, Colorado State Land Board, FS, BLM, and USFWS. WS-Colorado also recognizes the sovereign rights of Native American tribes to manage wildlife on tribal properties, and has invited federally recognized tribes in Colorado to cooperate or participate in the development of this EA. The WS-Colorado program is committed to coordinating with all applicable land and resource management agencies including tribes when PDM activities are requested.

1.15.2 How Will this EA Be Used to Inform WS-Colorado's Decisions?

As a federal agency, all WS-Colorado activities must comply with NEPA. WS-Colorado will use the analyses in this EA to help inform our decision whether to continue requested PDM activities in Colorado. This EA will also aid in our decision to prepare an EIS or a FONSI.

WS-Colorado has previously prepared the following EAs for its PDM program in Colorado:

- 2017 EA and Decision/FONSI for Predator Damage Management in Colorado (WS 2017a)
- 2005 EA and Decision/FONSI for Predator Damage Management in Colorado
- 1999 EA and Decision/FONSI for Predator Damage Management in Eastern Colorado
- 1997 EA and Decision/FONSI for Predator Damage Management in Western Colorado

This EA will supersede and replace those listed above when the Decision document is signed. This document will report our finding of either no significant impact (FONSI), or significant impact warranting the preparation of an EIS.

1.15.3 How Does this EA Relate to Site-Specific Analyses and Decisions?

Many of the species addressed in this EA can be found statewide, and damage or threats of damage can occur wherever those species overlap with human resources or activities. The exact timing and location of individual requests for PDM assistance are difficult to predict. This precludes the inclusion of site-specific analyses in this EA. WS-Colorado must be ready to provide assistance on short notice anywhere in Colorado to protect any resource or human/pet health or safety upon request. The analyses in this EA are intended to apply to any action that may occur in any location and at any time within Colorado for which WS-Colorado may provide PDM assistance. The analyses in Chapter 3 cover this scope of work, which represents the maximum level of PDM expected under Alternative 1.

The APHIS-WS Decision Model (Section 2.6.2) is the site-specific procedure for individual actions conducted by WS-Colorado personnel in the field when they respond to requests for assistance. Site-specific decisions made using the model are in accordance with NEPA Decisions, and incorporate applicable WS Directives, relevant laws and regulations, interagency agreements and MOUs, and cooperating agency policies and procedures. Using the Decision Model for field operations, this EA meets the intent of NEPA with regard to site-specific analysis and informed decision-making, as well as providing timely assistance to agencies and cooperators per WS-Colorado's objectives. These site-specific actions are included in the analyses in Chapter 3.

Site-specific limitations are sometimes outlined in ADMs. All PDM which might be conducted under these ADMs is included and analyzed in this EA, as discussed in Section 1.14.1. For example, an ADM might identify specific methods which will not be used in certain areas, or areas where PDM will generally not be conducted, based on management practices for those lands.

1.15.4 What is the Geographic Scope of this EA?

The geographic scope of this EA is the State of Colorado. Areas in which WS-Colorado PDM activities occur encompass rural and urban areas, including: residential and commercial development; rangelands, pastures, ranches and farms; agricultural croplands; timber and forested areas; recreation areas and trails; airports; wilderness and wilderness study areas; and other places where predator conflicts may occur.

Routinely, operational areas may include private lands, federal lands, state lands, municipal lands, and tribal lands. Colorado is comprised of roughly 56% private lands, 36% Federal lands, 5% State lands, 2% tribal, and 1% local government lands (Vincent et al. 2017, Colorado State Land Board 2017, Farmland Information Center 2017).

1.15.4.1 Private Lands

Private and commercial property owners and/or managers of private property request WS-Colorado for assistance to manage predator damage and threats. Private property includes areas in private ownership in urban, suburban, and rural areas, including agricultural lands, timberlands, pastures, residential complexes, subdivisions, and businesses.

1.15.4.2 Federal Property

Per the MOUs with the USFS and BLM, WS-Colorado responds to permittee and agency requests for PDM to protect livestock on federal grazing allotments, and for the protection of human safety. WS-Colorado coordinates with the agencies prior to the grazing/recreation seasons to identify needs, types of operations, and restrictions (documented in an ADM), and reports annually to the agencies on our activities. WS-Colorado also responds to requests for assistance from the USFWS for protection of ESA-listed species.

1.15.4.3 State and Municipal Property

Activities are conducted on properties owned and/or managed by the state or Colorado municipalities when requested. Such properties can include parks, forestland, historical sites, natural areas, scenic areas, conservations areas, and campgrounds. Sometimes private landowners that are being affected by predators that reside in habitat located on adjacent public lands may request assistance. The adjacent property owner/manager may agree to allow PDM activities to occur to assist the affected landowner.

1.15.4.4 Tribal Property

Tribal governments and land managers can request assistance from WS-Colorado for PDM on lands under their authority and/or ownership. Predators have an important role in tribal culture and religious beliefs. WS-Colorado continues to work with tribes to address their needs through consultation for this EA, with policy, and in the field as requested.

Native American tribes may choose to work with relevant cooperating agencies for meeting PDM needs, request assistance from WS-Colorado, hire commercial control companies, or conduct their own work. Any participating Tribes would need to make their own decision regarding the management alternatives they choose to implement. WS-Colorado respects the rights of sovereign tribal governments, provides early opportunities for all federally-recognized tribes in Colorado to participate in planning and developing PDM strategies affecting tribal interests through consultations, cooperating agency status, and government-to-government relationships consistent with USDA APHIS Directive 1040.3 and federal policy.

1.15.5 For What Period of Time is this EA Valid?

There is no specific time limit for this EA. If WS-Colorado determines that the analyses in this EA indicate that an EIS is not warranted (impacts are not significant per 40 CFR §1508.27), this EA remains valid until WS-Colorado determines that new or additional needs for action, changed conditions, new issues, and/or new alternatives having different environmental impacts need to be analyzed in order to keep the information and analyses current.

WS-Colorado will monitor PDM activities to ensure that those activities and their impacts remain consistent with the activities and impacts analyzed in this EA and selected as part of the decision. Monitoring includes review of adopted mitigation measures and target and non-target take reported and associated impacts analyzed in the EA. Monitoring ensures that program effects are within the limits of evaluated/anticipated take in the selected alternative. Monitoring involves review of the EA for all of the issues evaluated in Chapter 3 to ensure that the activities and associated impacts have not changed substantially over time.

Supplements or changes which would have "environmental relevance" (40 CFR 1502.9(c)) might be added to this EA as appropriate. A new EA, which will supersede and replace this EA, will be prepared if there is sufficient new information available that indicates a new NEPA analysis and decision is warranted.

1.16 Why is WS-Colorado Preparing an EA Rather than an EIS?

1.16.1 What is the Purpose of an Environmental Assessment?

The primary purposes of an EA are to (1) determine if the environmental impacts of the proposed action might be significant, which would warrant the preparation of an EIS; and (2) to determine whether an alternative to the proposed action would be more appropriate [40 CFR 1508.9(a)(3) and 40 CFR 1501.4]. As such, this EA was prepared so that WS-Colorado can make an informed decision on whether or not an EIS is warranted for the WS-Colorado PDM program, and whether an alternative to the proposed action would be more appropriate.

WS-Colorado also prepared this EA to clearly communicate our analysis of individual and cumulative impacts of our actions to the public (using guidance at 40 CFR §1506.6), and to facilitate planning and interagency coordination.

In order to make this decision, this EA includes a thorough analysis of direct, indirect, and cumulative impacts associated with WS-Colorado PDM activities. WS-Colorado addresses all anticipated issues and reasonable alternatives in this EA.

This EA includes thorough and comprehensive analyses of the impacts and effectiveness of four alternatives for addressing PDM in Colorado, including no WS-Colorado activities at all (Section 2.9), in compliance with NEPA Section 102(2)(E). It also documents compliance with other environmental laws, such as the Endangered Species Act, describes the current WS-Colorado activities and alternatives in detail, and provides rationale for not considering other alternatives and issues in detail.

WS-Colorado provides for public involvement in its EA processes by inviting public comment on pre-decisional EAs, and agency involvement by inviting cooperating and commenting agencies to review and comment on an internal interagency draft prior to public release. WS-Colorado will provide a 45-day review and comment period on the pre-decisional draft of the EA for the public and interested parties to provide comments regarding new issues, concerns, and/or alternatives. Using the guidance provided in 40 CFR §1506.6 for public involvement, WS-Colorado will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. Public notification processes regarding the final NEPA document and decision will be identical to those used for the pre-decisional EA, with the addition of direct contact with commenters.

If WS-Colorado makes a determination based on this EA that the selected alternative would have a significant impact on the quality of the human environment, then WS-Colorado will publish a Notice of Intent to prepare an EIS, and this EA would be the foundation for developing the EIS, per the CEQ implementing regulations (40 CFR §1508.9(a)(3)).

1.16.2 Why is this EA limited to PDM in the State of Colorado?

APHIS-WS has determined that PDM is sufficiently different from other APHIS-WS activities as to warrant separate NEPA analysis. Therefore, this EA is limited to PDM. Other WS-Colorado activities which might impact predator species will be included in the analyses herein (*e.g.*, population impact analyses in Section 3.1.1), because these are connected actions. For example, if a native predator was taken as a non-target during an attempt to manage birds or aquatic rodents, that take will be included in this EA. APHIS-WS has also determined that the management of wildlife in the various states, including state laws and regulations, is different enough as to warrant separate NEPA analyses for each state. In addition, most state-resident wildlife species are managed under state authority or law, without any federal oversight or protection. Therefore, this EA is limited to the State of Colorado.

1.16.3 How will WS-Colorado Evaluate Significant Impacts

NEPA (42 U.S.C. 4321 *et seq*.) requires a "*detailed statement*" for all "*major Federal actions significantly affecting the quality of the human environment*." CEQ defines this "*detailed statement*" as an Environmental Impact Statement (EIS). The process for determining if a project or program may have "significant" impacts is based on the CEQ regulations at 40 CFR §1508.27. In Chapter 3 of this EA, WS-Colorado will evaluate these potential impacts in two ways, according to these CEQ regulations: (1) the severity or magnitude of the impact, and (2) the context of the impact. Context is especially important when the resource is rare or vulnerable.

These CEQ regulations (40 CFR §1508.27) provide factors for consideration in determining whether impacts are significant, including: "*unique characteristics of the geographic area*;" "*effects on the quality of the human environment*;" the degree of uncertainty; cumulative impacts; impacts on "*significant scientific, cultural, or historical resources*;" and impacts on threatened or endangered species.

One particular factor cited by CEQ warrants some clarification. In 40 CFR §1508.27(b)(4), CEQ directs federal agencies to consider "*the degree to which the effects on the quality of the human environment are likely to be highly controversial*." Disagreement with a particular federal action by any organization(s) or person(s) does not constitute such controversy. In this context, "*highly controversial*" refers to controversy over the impact (whether the magnitude of the impact is in dispute; *Hanly v. Kleindienst 1972*), or controversy over the likely impacts of the action (CEQ 2014), not controversy over the action itself, or whether it should be performed.

WS-Colorado will include all of these CEQ considerations in Chapter 3, using the best available data to determine the magnitude of the impacts, including data from wildlife agencies having jurisdiction by law (CPW, CDA, and USFWS; 40 CFR §1508.15), and peer-reviewed and other published literature. This includes the analysis of differing professional conclusions, recommendations, and opinions, especially those published in peer-reviewed, scientific journals. Under NEPA, WS-Colorado must use "information of high quality" (40 CFR § 1500.1(a)) and "professional integrity" (40 CFR §1502.24). The published, peer-reviewed, or otherwise scientifically-collected data used in the analyses in Chapter 3 meets these standards.

We used federal fiscal year 2012 through 2016 (FY12-16) as the internal analysis period for this EA; data from the WS Management Information System (MIS) pertaining to WS-Colorado PDM conducted in these years was used for the analyses in Chapter 3.

Potential impacts on wildlife species in Chapter 3 will be analyzed by statewide populations, because the authority for management of most wildlife species occurs at the state level. Some wildlife species are managed by CPW at more local levels, referred to as Data Analysis Units (DAUs). These species include deer, elk, pronghorn, black bears, mountain lions, and others. In addition, the need for PDM is often unpredictable, so WS-Colorado cannot predict what PDM actions might be warranted in specific areas of the state. The potential for short-term, temporary changes to localized populations of target predator species are not generally considered "significant", because they are unlikely to result in any negative impacts on the environment. WS-Colorado collaborates with CPW to monitor the potential for impacts on wildlife populations in Colorado.

CPW has management authority over the management of most wildlife species in Colorado, and the decision of CPW to effect a change in the population of any species which it manages would not necessarily be considered a significant impact. An increase or decrease in a wildlife population is not necessarily a significant impact. In order to be considered significant, the magnitude of the population change must be substantial, such as a change which results in the population being unable to sustain itself, major changes to other species populations, major alterations in ecosystem function (such as biodiversity or trophic cascades), or other significant impacts on the quality of the human environment (including increased predator damage). These are the kinds of factors which would trigger a determination of significant impact.

1.16.4 What Is the Environmental Baseline Used by WS-Colorado to Evaluate Significant Impacts?

To determine impacts of federal actions on the human environment, an environmental baseline needs to be established with respect to the issues considered in detail, so that the impacts of the alternatives can be compared against this baseline. The environmental baseline has been defined to include "the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process" (50 CFR 402.02(d)). This definition is for the USFWS implementation of the ESA; however, the definition is useful in that it clarifies what might be considered as the environmental baseline.

The baseline appropriate for the analyses in this EA is not a "pristine" or "non-human-influenced" environment, but one that is already heavily influenced by human actions including WS-Colorado PDM which have been conducted in Colorado for more than a century, and PDM conducted by other federal, state, and local agencies, as well as individuals and other entities. Thus, the baseline impacts are those for Alternative 1, the proposed action/no action alternative, as described in Section 2.6. The analyses in Chapter 3 of this EA uses the best available information to determine the impacts of the proposed action and alternatives on the current environmental baseline.

1.16.5 How Do Key Statutes and Executive Orders Apply to the WS-Colorado Program?

Numerous federal statutes and executive orders apply to the WS-Colorado program, including PDM conducted by WS-Colorado. Some of the key documents are described below; see Appendix F for a more complete list.

1.16.5.1 Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)

All pesticides used or recommended for cooperator use are registered with and regulated by the US Environmental Protection Agency (EPA) and CDA. WS-Colorado uses or recommends for use all chemicals according to label requirements as regulated by EPA and CDA.

1.16.5.2 Endangered Species Act (ESA)

Under the ESA (16 United States Code (U.S.C.) 1531 et seq., Endangered Species Act (ESA) of 1973, as amended; 16 U.S.C. 703-712), all federal agencies will seek to conserve threatened and endangered species and will utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). WS conducts Section 7 consultations with the United States Fish and Wildlife Service (USFWS) to use the expertise of the USFWS to ensure that "*any action authorized, funded or carried out by such an agency…is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency will use the best scientific and commercial data available*" (Sec.7 (a)(2)). WS-Colorado has consulted with the USFWS regarding its current program. See Section 3.6, Appendix C, and Appendix D for details on consultations and results.

1.16.5.3 National Historic Preservation Act

WS-Colorado has reviewed its program per this EA and continues to conclude that the program is not an “undertaking” as defined by National Historic Preservation Act of 1966, as Amended (Public Law 102-575; 16 USC 470) and that consultation with the State Historic Preservation Office is not necessary. WS-Colorado works closely with the USFS and BLM on public lands to ensure there are no conflicts with cultural resources. WS-Colorado has also reached out to tribes as discussed under “Consultation and Coordination with Indian Tribal Governments” in this section. Each of the methods described in the EA that may be used operationally and locally by WS-Colorado does not cause major ground disturbance, does not cause any physical destruction or damage to property, does not cause any alterations of property, wildlife habitat, or landscapes, and does not involve the sale, lease, or transfer of ownership of any property. In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be used by WS-Colorado under the proposed action are not generally the types of activities that would have the potential to affect historic properties.

If an individual activity with the potential to affect historic resources is planned under an alternative selected as a result of a decision based on the analysis in this EA, then site-specific consultation as required by Section 106 of the National Historic Preservation Act would be conducted as necessary.

1.16.5.4 Consultation and Coordination with Indian Tribal Governments (Executive Order 13175).

WS-Colorado recognizes the rights of sovereign tribal nations, the unique legal relationship between each Tribe and the federal government, and the importance of strong partnerships with Native American communities. WS-Colorado is committed to respecting tribal heritage and cultural values when planning and initiating WDM programs. Consultation and coordination with tribal governments is conducted consistent with Executive Order 13175 and APHIS-WS' plan implementing the executive order. WS-Colorado has offered early opportunities for formal government-to-government consultation on its proposed program to all Tribes in Colorado, and has requested their involvement for this EA through direct invitations and agency draft EA review opportunities.

1.16.5.5 Fish and Wildlife Act of 1956 Section 742j-1 – Airborne Hunting

The USFWS has delegated permitting of aerial PDM within Colorado to the State of Colorado, specifically CDA. WS-Colorado obtains permits from CDA to conduct aerial PDM. Other commercial, private, and lower governmental entities must also obtain a permit from CDA for use of aerial operations for predator removals.

1.16.5.6 Compliance with Executive Order 12898 "Environmental Justice"

WS-Colorado personnel use damage management methods as selectively and environmentally conscientiously as possible. All chemicals used by APHIS-WS are regulated by the EPA through FIFRA, CDA, by MOUs with Federal land management agencies, and by APHIS-WS Directives. In Chapter 3 of this EA, WS-Colorado provides a risk assessment of chemicals used during PDM.

1.16.5.7 Executive Order 13045 "Protection of Children"

Children may suffer disproportionately from environmental health and safety risks, including their developmental physical and mental status, for many reasons. APHIS-WS policy is to identify and assess environmental health and safety risks and avoid or minimize them, and WS-Colorado has considered the impacts that alternatives analyzed in this EA might have on children. All WS-Colorado PDM is conducted using only legally available and approved damage management methods where it is highly unlikely that children would be adversely affected. See Appendix A for a detailed description of all damage management methodologies included in the WS-Colorado program and Chapter 3 for an analysis of their impacts.

1.16.5.8 Incorporating Ecosystem Services into Federal Decision Making (Presidential Memorandum 10/7/2015)

This memorandum directs Federal agencies to develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments, and regulatory contexts. This effort includes using a range of qualitative and quantitative methods to identify and characterize ecosystem services, affected communities' needs for those services, metrics for changes to those services, and, where appropriate, monetary and nonmonetary values for those services. It also directs Federal agencies to integrate assessments of ecosystem services, at the appropriate scale, into relevant programs and projects, in accordance with their statutory authority.

1.16.5.9 The Wilderness Act

The Wilderness Act (Public Law 88-577; 16 USC 1131-1136; September 3, 1964) preserved management authority for fish and wildlife with the state for those species under state jurisdiction. Some portions of wilderness areas in Colorado have historic grazing allotments and WS-Colorado may conduct limited PDM in them in compliance with federal and Colorado laws. See Section 3.5 for an analysis of impacts on federal lands, including wilderness areas. WS-Colorado only provides assistance to requesting entities in designated wilderness areas when allowed under the provisions of the specific wilderness legislation and as specified in MOUs between APHIS-WS and the land management agencies.

The Wilderness Act does not prohibit WDM within designated wilderness. With certain exceptions, the Act prohibits using motorized equipment and motorized vehicles such as ATVs and landing of aircraft. The Forest Service and BLM may approve WDM in wilderness study areas and wilderness (Forest Service Manual 2323 and BLM Manuals 6330 and 6340 respectively). WS-Colorado works closely with the BLM and Forest Service in implementing PDM in wilderness and wilderness study areas.

1.16.5.10 The Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA; 16 USC 703-712), as amended, provides the USFWS regulatory authority to protect native species of birds that migrate outside the United States. The law prohibits any "take" of these species, except as permitted by the USFWS. The MBTA established a federal prohibition, unless permitted by regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird. FWS released a final rule on November 1, 2013 identifying 1,026 birds on the List of Migratory Birds [78 Fed. Reg. 212(65844-65864)].

1.16.5.11 The Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal penalties for persons who "*take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof*." The Act defines "*take*" as "*pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb*."

1.16.5.12 The Federal Food, Drug, and Cosmetic Act (21 USC 360)

This law places administration of pharmaceutical drugs, including those immobilizing drugs used for wildlife capture and handling, under the United States Food and Drug Administration.

1.16.5.13 The Controlled Substances Act of 1970 (21 USC 821 *et seq*.)

This law requires an individual or agency to have a special registration number from the United States Drug Enforcement Administration to possess controlled substances, including controlled substances used for wildlife capture and handling.

1.16.5.14 The Animal Medicinal Drug Use Clarification Act of 1994

The Animal Medicinal Drug Use Clarification Act and its implementing regulations (21 CFR 530) establish several requirements for the use of animal drugs, including those animal drugs used to capture and handle wildlife. Those requirements are: (1) a valid "veterinarian-client-patient" relationship, (2) well defined record keeping, (3) a withdrawal period for animals that have been administered drugs, and (4) identification of animals. A veterinarian, either on staff or on an advisory basis, would be involved in the oversight of the use of animal capture and handling drugs under any alternative where WS-Colorado would use those immobilizing and euthanasia drugs.

1.17 What is the Need for the WS-Colorado PDM Program?

1.17.1 What is the Need for WS-Colorado PDM Activities?

Two independent government audits, one conducted at the request of Congress, the other in response to complaints from the public and animal advocacy groups to USDA, found that, despite cooperator implementation of non-lethal actions such as fencing and herding, a need exists for APHIS-WS' PDM activities. APHIS-WS management actions for predator damage was determined by these audits to be needed for the protection of: human safety and health; crops and livestock; other species, including threatened and endangered species, game and furbearer species, and recently reintroduced native species, as determined by the wildlife management agency; and property and other assets.

WS-Colorado commonly provides technical assistance, including advice, training, and educational materials, to individuals, communities, and groups to better understand how to coexist with wildlife and reduce the potential for conflicts.

Whenever possible, WS-Colorado personnel recommend that cooperators take non-lethal action in lieu of or in addition to direct and sometimes lethal actions taken by WS-Colorado personnel. However, the appropriate strategy for a particular set of circumstances must be determined on a case-by-case basis, using the APHIS-WS Decision Model, and in integrated approach to PDM.

Predators are responsible for the depredation of a wide variety of livestock, other agricultural resources, property and natural resources (Table 1-3). In addition, predators can be a threat to human health and safety (*e.g.*, in 1991 an 18-year-old male was killed by a mountain lion while jogging in Clear Creek County, Colorado). Figure 1-4 shows the amount of damage from select predators recorded by WS-Colorado within this timeframe. This is an indication of the need for PDM, but it represents only a portion of the need. Connolly (1992) determined that only a fraction of the total predation attributable to coyotes is reported to or confirmed by WS-Colorado. He also determined that, based on scientific studies and livestock loss surveys generated by the National Agriculture Statistics Service (NASS), WS-Colorado only confirms about 19% of the total adult sheep and 23% of the lambs actually killed by predators. Producers do not report all losses to WS-Colorado, and WS-Colorado Specialists do not attempt to locate every livestock kill reported by ranchers. The goal of WS-Colorado Specialists is to verify sufficient losses to determine if a predator problem exists which requires PDM actions. Therefore, WS's damage and loss reports are not intended to reflect the total number of livestock lost in the State. But they do provide an index of the annual losses.

Total losses reported to WS-Colorado were $1,512,440 during FY12-16. Most of these losses were to livestock, with losses of 6,593 head of livestock valued at $1,195,396. These values represent only a fraction of the total losses, because not all losses are reported to WS-Colorado. In general, the only losses reported to WS-Colorado are those for which a cooperator hopes to limit future losses by working with WS-Colorado to conduct PDM. Consequently, certain types of losses are, by nature, not included in these data. This includes losses to natural resources, and quite often pets.

Table 1-3 summarizes the average losses reported to WS-Colorado. In all prior PDM EA's for WS-Colorado, coyotes were the most damaging species. However, during FY12-16, black bears caused the most damage: $129,787 per year, which is 43% of the total damage. This does not reflect a decrease in the amount of damage caused by coyotes, but rather, a major increase in the amount of damage caused by black bears. Most damage from black bears was inflicted on livestock and human health & safety. The losses recorded to human health & safety include only those damages on which a value could be placed: rescue, medical, and tracking costs. No attempt was made to put a value on human injuries or fatalities. WS-Colorado recorded an average of two black bear attacks per year which caused human injury or death.

Based on the losses reported to WS-Colorado, coyotes caused the 2nd most damage, valued at $110,748 per year, which is 37% of the total damage. This was almost entirely due to livestock losses. Approximately 1% of these losses were to crops. Coyotes are omnivorous, and will often eat crops, including cantaloupe and watermelons, which are commonly grown in southeastern Colorado. Coyotes also caused sporadic losses to pets and zoo animals. As noted, these data do not likely include all losses suffered in Colorado, especially for pets, because pet owners are not likely to contact WS-Colorado regarding such losses.

Table 1-3. Average annual losses due to predators in Colorado recorded by WS Specialists from FY12 through FY16. Numbers are the averages among these five FY's, rounded to the nearest whole number. Data include only those losses reported to (or verified by) WS Specialists, and recorded in MIS.

Predator Species	Livestock		Crops[a]	Other Agri.[a]	Pets & Zoo Animals		Property[a]		Human Health & Safety[a]		Natural Resources		Total
	#[b]	Value	Value	Value	#[b]	Value	#[b]	Value	#[b]	Value	#[b]	Value	Value
Black Bear	501	$86,375	$7,333	$2,399	-	-	10	$4,380	2	$29,300	-	-	**$129,787**
Coyote	631	$109,631	$1,017	-	<1	$100	-	-	-	-	-	-	**$110,748**
Mountain Lion	106	$34,503	-	-	<1	$4,150	-	-	<1	$2,000	-	-	**$40,653**
Raccoon	11	$249	$7,255	$453	1	$10	13	$2,800	-	-	-	-	**$10,767**
Red Fox	53	$3,985	-	$40	-	-	-	-	-	-	-	-	**$4,025**
Feral Dog	9	$3,916	-	-	-	-	-	-	-	-	-	-	**$3,916**
Striped Skunk	-	-	<$1	-	-	-	11	$2,020	-	-	-	-	**$2,020**
Bobcat	8	$413	-	-	-	-	-	-	-	-	-	-	**$413**
Badger	<1	$8	$2	-	-	-	<1	$130	-	-	-	-	**$139**
Opossum	-	-	-	-	-	-	<1	$20	-	-	-	-	**$20**
Total	**1,318**	**$239,079**	**$15,607**	**$2,892**	**1**	**$4,260**	**35**	**$9,350**	**2**	**$31,300**	-	-	**$302,488**

[a] "Crops" includes field crops and tree crops such as fruits and nuts; "Other Agri." is other agriculture, including hives, aquaculture, worms, eggs, pasture, irrigation systems, and feed; "Property" includes turf, structures, landscaping, guard animals, and aircraft; "Human Health & Safety" includes only verified attacks on humans. Values associated with attacks on humans include rescue, medical, and tracking costs, when known. No attempt was made to place a value on human injuries or fatalities.

[b] Numbers of animals includes animals killed or injured; number of items includes items damaged or destroyed; human health & safety is reported as number of incidents of verified attacks on humans.

"-", no recorded losses in MIS during the specified timeframe.

Mountain lions caused the 3rd most damage, valued at $40,653, which is 13% of the total damage. Most of this was livestock losses, but losses to pets and zoo animals, and human health & safety were also recorded. This includes monetary losses involved in the attack of a 5-year old boy in 2016. As noted, these losses only include rescue, medical, and tracking costs. These three predators combined were responsible for 93% of the damage recorded by WS-Colorado. Raccoons also caused a large amount of damage, including an annual average of $10,767 in losses to crops, pets and zoo animals, and some livestock (chickens and pigeons) (Table 1-3).

1.17.2 What is the Need for PDM to Protect Livestock in Colorado?

Predators prey on a wide variety of livestock, including cattle, sheep, goats, swine, horses, and poultry. Sheep, goats, cattle (especially calves), and poultry are highly susceptible to predation throughout the year (Henne 1975, Nass 1977, Tigner and Larson 1977, Nass 1980, O'Gara *et al.* 1983, Bodenchuk *et al.* 2002). For example, cattle, calves, sheep, and goats are especially vulnerable to predation during calving, lambing, and kidding seasons in the late winter and spring (Sacks *et al.* 1999b, Bodenchuk *et al.* 2002, Shwiff and Bodenchuk 2004). Tables 1-4 and 1-5 summarize annual losses reported to WS-Colorado Specialists due to sheep and lambs (Table 1-4), and cattle and calves (Table 1-5). These losses are only those reported to WS-Colorado during FY12-16.

Table 1-4. Annual sheep and lamb losses due to predators in Colorado recorded by WS Specialists from FY12 through FY16. Data include only those losses reported by cooperators or verified by WS Specialists, and recorded in MIS.

Predator Species	FY 2012		FY 2013		FY 2014		FY 2015		FY 2016		Average	
	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value
Badger	-	-	-	-	-	-	-	-	-	-	-	-
Black Bear	636	$117,300	279	$33,672	461	$56,968	526	$65,093	453	$69,345	**471**	**$68,476**
Bobcat	-	-	-		-	-	2	$249	3	$494	**3**	**$372**
Feral Cat	-	-	-	-	-	-	-	-	-	-	-	-
Coyote	866	$132,596	446	$50,177	489	$52,432	537	$67,389	422	$60,237	**552**	**$72,566**
Feral Dog	13	$3,225	-	-	-	-	-	-	7	$834	**10**	**$2,030**
Red Fox	19	$4,260	18	$2,390	10	$1,002	51	$6,338	7	$1,157	**21**	**$3,029**
Swift Fox	-	-	-	-	-	-	-	-	-	-	-	-
Mountain Lion	64	$12,780	93	$11,440	22	$2,383	75	$9,279	42	$5,931	**59**	**$8,363**
Opossum	-	-	-	-	-	-	-	-	-	-	-	-
River Otter	-	-	-	-	-	-	-	-	-	-	-	-
Raccoon	-	-	-	-	-	-	-	-	-	-	-	-
Spotted Skunk	-	-	-	-	-	-	-	-	-	-	-	-
Striped Skunk	-	-	-	-	-	-	-	-	-	-	-	-
Total	**1,598**	**$270,161**	**836**	**$97,679**	**982**	**$112,785**	**1,191**	**$148,348**	**934**	**$137,998**	**1,116**	**$153,394**

"-", no recorded losses in MIS during the specified timeframe.

Bear predation on livestock has increased sharply over the last decade. The number of hours expended by WS-CO has increased along with funds expended by livestock producers to reduce losses (WS 2016d). WS-Colorado expended about 900 staff hours in 2005 alleviating bear predation on livestock. This increased to about 2,900 hours in 2010 and has been at this level of loss for 3 of the last 5 years (WS 2016d). The number of sheep lost to bear predation varies annually and coincides with effort expended to reduce bear predation losses. For example, WS-CO verified 198 sheep killed by bears in 2005 and then the losses trended upward matching peek predation years in 2010, 2012, 2014 and 2015 when 639, 636, 461, and 526 were verified killed by black bears in Colorado. The State of Colorado makes damage payments to livestock and other agricultural producers that range from $300,000 to $450,000 annually (CPW 2015b). The largest payments for bear damage are for sheep predation. The amount of bear damage payments has been trending upward since 2005 while the number of claims has declined (CPW 2015b). Also, during this time period legal hunter harvest has increased from about 450 bears in 2005 to almost 1,400 bears in 2014. During the same time period damage payments have increased, hours expended to alleviate predation on livestock has tripled, hunter harvest has tripled and black bear populations in Colorado increased from 12,000 bears in 2002 to an estimated 17,000-20,000 bears in 2015 (CPW 2015b).

Table 1-5. Annual cattle and calf losses due to predators in Colorado recorded by WS Specialists from FY12 through FY16. Data include only those losses reported by cooperators or verified by WS Specialists, and recorded in MIS.

Predator Species	FY 2012		FY 2013		FY 2014		FY 2015		FY 2016		Average	
	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value
Badger	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Black Bear	19	$14,552	5	$5,142	19	$37,747	4	$4,072	3	$1,612	**10**	**$12,625**
Bobcat	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Feral Cat	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Coyote	29	$20,427	64	$54,090	71	$57,468	16	$7,792	47	$20,938	**45**	**$32,143**
Feral Dog	-	-	$6	$4,712	$8	$8,927	-	-	-	-	**7**	**$6,820**
Red Fox	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Swift Fox	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Mountain Lion	4	$3,785	5	$3,927	-	-	2	$1,406	2	$811	**3**	**$2,482**
Opossum	-	-	-	-	-	-	-	-	-	-	**-**	**-**
River Otter	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Raccoon	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Spotted Skunk	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Striped Skunk	-	-	-	-	-	-	-	-	-	-	**-**	**-**
Total	**52**	**$38,764**	**80**	**$67,871**	**98**	**$104,142**	**22**	**$13,270**	**52**	**$23,361**	**66**	**$49,482**

"-", no recorded losses in MIS during the specified timeframe.

Not all producers suffer losses due to predators; however, for those producers that do, the losses can be economically burdensome, and may cause small producers to experience years of negative profits (Fritts *et al.* 1992, Mack *et al.* 1992, Shelton 2004, Rashford *et al.* 2010). In Colorado, 10.4-12.4% of sheep producers and 4.4% of cattle producers reported losses due to predators during 2014 and 2015, respectively (NASS 2015, VS 2017). Losses are not evenly distributed among producers, and may be concentrated on some properties where predator territories overlap livestock, and predators learn to deviate from their natural prey base to domestic livestock as an alternative food source (Shelton and Wade 1979, Shelton 2004). Therefore, predation can disproportionately affect certain properties and further increase a single producer's economic burden (Nass 1977, Howard and Shaw 1978, Nass 1980, O'Gara *et al.* 1983, Bodenchuk *et al.* 2002, Shelton 2004, Rashford *et al.* 2010). Shwiff and Bodenchuk (2004) state that profit margins in livestock production do not allow a 20% loss rate, and the absence of PDM, such losses would likely result in the loss of the livestock enterprise. Without effective methods of reducing predation rates such as those used by APHIS-WS, economic losses due to predation continue to increase (Nass 1977, Howard and Shaw 1978, Nass 1980, O'Gara *et al.* 1983, Bodenchuk *et al.* 2002).

1.17.2.1 What is the Contribution of Livestock to Colorado's Economy?

In 2015, agriculture generated $7.4 billion in annual sales from farm and ranch commodities in Colorado (NASS 2016). Livestock production, primarily cattle, sheep, swine, and poultry, accounted for $5.2 billion (70%) of this, and is therefore considered a primary agricultural industry sector in the state. Cattle, sheep, and swine production contributes substantially to local economies. Colorado livestock inventories in 2015 included 2.7 million cattle and calves, 435,000 sheep and lambs, 700,000 swine, and 5.8 million chickens (NASS 2016). In addition, goats, other poultry, rabbits, ratites (ostriches and emus), and exotic livestock are produced in Colorado, but at lower levels. Sheep inventories in Colorado have increased over the last 10 years from a low of 370,000 in 2010 (NASS 2016).

1.17.2.2 What Do Studies Say About the Numbers of Livestock Losses Due to Predators?

Livestock losses can come from a variety of sources, including disease, weather conditions, market price fluctuations, and predation (Blejwas *et al.* 2002). Producers routinely address disease concerns through responsive and preventative veterinary care and weather concerns through husbandry practices. Business practices address concerns with market fluctuations. These concerns must be dealt with by producers as part of their business operation. However, this EA addresses livestock losses through predation and in the context of APHIS-WS statutorily authorized activities and appropriations and, therefore, focuses on this issue.

Rates of loss of different types of livestock in the presence and absence of PDM can vary widely. It is difficult to compare the findings of studies because of different study methodologies, locations, circumstances, survey methods, whether losses are reported or confirmed, lack of finding all animals depredated, and variables that cannot be controlled during the studies, such as weather and disease. However, these findings can be an indicator of levels of losses with and without PDM activities:

- Losses in the absence of direct PDM activities have been estimated to include:
  - Adult sheep ranged from 1.4% to 8.4%, lambs ranged from 6.3% to 29.3% (Shwiff and Bodenchuk 2004);
  - Adult doe goat losses were 49% and kids 64% (Guthrey and Beasom 1977);
  - Lambs ranged from 12% to 29% and ewes 1% to 8% when producers were compensated for losses in lieu of PDM (Knowlton *et al.* 1999);
  - Adult sheep 5.7% (range 1.4% to 8.1%), lambs 17.5% (range 6.3% to 29.3%), and calves (3%) (Bodenchuk *et al.* 2002);
  - Total sheep flock ranged from 3.8% in California to almost 100% of lambs in a South Texas study (Shelton and Wade 1979);
  - Adult sheep and lambs can range from 8.3% to 29.3%, respectively (Henne 1975, Munoz 1977, O'Gara *et al.* 1983);
  - Lambs could be as high as 22.3% (McConnell 1995 in: Houben *et al.* 2004).
- Losses with direct PDM activities in place:
  - Adult sheep 1.6%, lambs 6%, goats and kids 12%, and calves 0.8% (Bodenchuk *et al.* 2002);
  - Lambs 1% to 6% (Knowlton *et al.* 1999);
  - Lamb losses can be as low as 0.7% (Nass 1977, Tigner and Larson 1977, Howard and Shaw 1978, Wagner and Conover 1999, Houben *et al.* 2004);
  - Lamb loss proportion to coyote predation was reduced from 2.8% to less than 1% on grazing allotments in which coyotes were removed 3 to 6 months before summer sheep grazing (Wagner and Conover 1999).

1.17.2.3 What Are Livestock Losses to Predators Nationally?

NASS is the National Agricultural Statistics Survey section of the US Department of Agriculture. It conducts the most comprehensive surveys of the status of agriculture in the US. The results of NASS surveys used in this EA are those which are pertinent to Colorado, either nationally or statewide, and which are the most recent.

Nationally, lamb losses due to predators represented 36.4% of the total lamb losses from all types of mortality in 2014. This predation loss accounts for 132,683 lambs killed, valued at $20.9 million (NASS 2015; Table 1-6). Calf losses due to predators represented 11% of total calf losses in 2015 (VS 2017). Cattle and calf losses have shown a 20 year trend of increasing predation losses nationally (VS 2017, Figure 1-1). This predation loss accounts for 238,900 calves killed by predators, at a value of $117.3 million in 2016 (VS 2017).

These losses occurred despite sheep operators spending $9.8 million on non-lethal methods in 2004 (NASS 2005). Non-lethal methods used by sheep producers included fencing (32%), night penning (20%), guard dogs (24%), and shed lambing (20%) in 2014 (NASS 2015). The use of non-lethal methods by sheep producers doubled from 2004 to 2014 (NASS 2015). In 2014, 58% of sheep producers used at least one non-lethal method, up from 32% in 2004 (NASS 2015).

The percentage of cattle operations which used non-lethal methods increased from 3% in 2000 to 19% in 2015 (VS 2017). Cattle operators spent an average of $2,962 per ranch on non-lethal methods in 2015 (VS 2017). Of those producers who used non-lethal methods, the most common methods were guard animals (26%); exclusion fencing (16%); frequent checking (5%); and culling older livestock to reduce predation or other risks (4%) (VS 2017). These surveys did not include information on any lethal management that might have been occurring simultaneously.

Table 1-6. The percentage of total losses nationally attributed to specific predator species and the associated amount of damage in terms of head of cattle-calves (VS 2017) and sheep-lambs (NASS 2015) and dollars lost for each.

	% Total Predator Loss		Number of Head		Value ($)	
Predator Species	**Calves**	**Lambs**	**Calves**	**Lambs**	**Calves**	**Lambs**
Coyotes	40.5	63.7	40,894	84,534	14,476,476	13,036,833
Dogs	11.3	10.3	6,934	13,701	2,454,636	2,112,968
Cougars/ Bobcats	5.8	4.5/ 2.8	5,519	5,920/ 3,736	1,953,726	912,982/ 576,165
Bears	1.0	3.0	--	4,018	--	619,656
Other[1]	11.1	15.7	18,112	26,629	9,426,666	4,106,724

[1] Includes calf losses from bears, foxes, wolves, ravens, eagles, vultures, and other known and unknown predator species; and lamb losses from foxes, wolves, vultures, ravens, feral swine, eagles, and other known and unknown predator species.

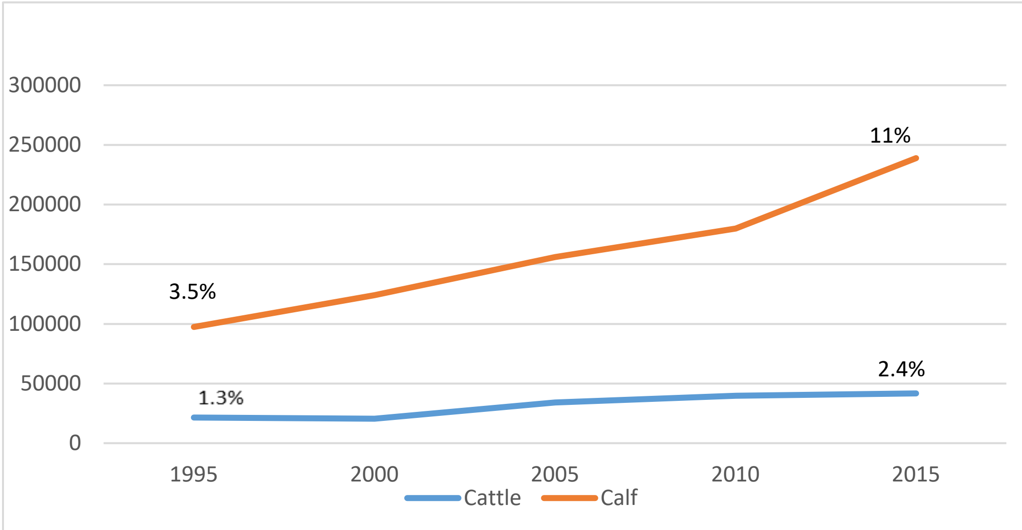

Figure 1-1. Number of and percentage of cattle and calves killed by predators nationally. Data from United States Department of Agriculture-Veterinary Services, 2017.

1.17.2.4 Which Predators Cause the Most Predation on Livestock?

Of the predators which kill livestock, coyotes are responsible for the highest percentage (Knowlton *et al.* 1999, Shelton 2004, VS 2017, NASS 2015). Coyotes account for 41% of all predator losses to cattle (VS 2017), and 64% of predator losses to lambs nationally (NASS 2015). In a study of sheep predation on rangelands in Utah (Palmer *et al.* 2010), coyotes accounted for the majority of lamb losses at 67%, with fewer losses attributed to cougars (31%) and black bears (2%). Other predators that cause measurable predation on cattle, calves, sheep and lambs are black bear, cougar, red fox and feral or free-roaming dogs.

1.17.2.5 What are Livestock Losses to Predators in Colorado?

NASS conducted a comprehensive national surveys of sheep lost to predators in 2014 (NASS 2015) and cattle lost to predators in 2015 (VS 2017). NASS (2015) reported that predators (coyotes, black bears, feral dogs, mountain lions, bobcats, and foxes) killed 5,100 adult sheep valued at $1,046,000, and 7,554 lambs valued at $1,511,000 in Colorado in 2014. The dollar value of lambs lost to predators tripled from 1999 to 2014 (NASS 2000, 2015). The percentage of sheep and lamb operations that reported losses to predators in 2014 in Colorado was 12.4% for sheep and 10.4% for lamb operations (NASS 2015). Of the sheep and lambs killed by predators in 2014, coyotes were responsible for about 60%, black bears 26%, mountain lion 6%, foxes 2%, and dogs 2% (NASS 2015). From 1999 to 2014, predation on sheep by black bears in Colorado has increased from 14% to 26% of the total predator losses, while that from dogs dropped from 13% to 2% (NASS 2000, 2015). This equated to 1,900 adult sheep and 1,391 lambs reported killed by black bears in Colorado in 2014 (NASS 2015). Nationally, back bears were responsible for only 3% of the predator losses to lambs and 5% of adult sheep. However, in Colorado, black bears were responsible for 26% of all predator losses to sheep and lambs (NASS 2015).

Cattle and calf predation losses in Colorado totaled 5,080 head valued at $3.1 million in 2015 (VS 2017). In Colorado, 4.4% of cattle operations reported losses to predators in 2015 (VS 2017). Black bear predation on cattle and calves is much greater in Colorado and Utah than nearly any other state, by a factor of 8-10 (VS 2017, Figure 1-2). Of predation losses to cattle in

2010, black bears were responsible for about 21%, coyotes 18%, and mountain lions 4% (NASS 2011). Of predator losses to calves in 2010, coyotes are responsible for 82%, black bears 8%, mountain lions 6% (NASS 2011). Numerically, reported coyote and bear predation on cattle and calves has increased over the last 20 years, especially reported black bear predation on cattle in Colorado (Figure 1-3). Reported black bear predation losses on cattle and calves combined more than doubled from 2010 to 2015 (Figure 1-3). Nationally, black bears were responsible for only 2% of total predator losses to cattle, and 1% of predator losses to calves (VS 2017). Black bears have become the most damaging predator for cattle producers, and their range is limited to central and western Colorado (Armstrong *et al.* 2011).

The production of cattle is different than that of sheep, as is the management of predation losses. CPW pays compensation to livestock producers who suffer losses from black bears and mountain lions. Whereas most sheep producers have herders to manage sheep, report predation losses almost daily, and provide timely information to the producer; cattle production is different, in part, because the predation risks have been less over the years. Cattle producers are more variable about management practices. Some ranches have cowboys who may check on cattle daily, weekly or monthly. Other ranches depend on the cattle producer to check the cattle and these checks may be less frequent. The CPW compensation program requires an investigation by CPW or WS-Colorado to verify the predator which caused the loss. Because cattle are checked less often than sheep, the verification of predator loss is difficult or sometimes impossible. Thus, cattle producers report fewer compensation claims, in part because they know requirements for compensation are unobtainable.

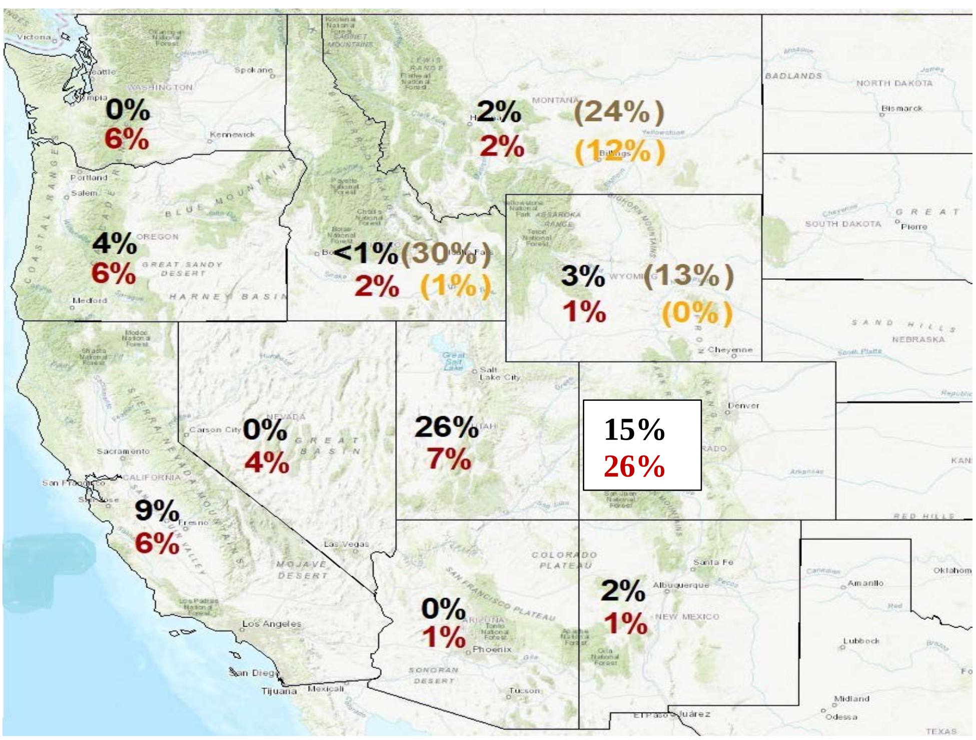

Figure 1-2. Reported black bear and grizzly bear (in parentheses) predation on cattle (top number) and calves (bottom number) in each state in 2015. Data is from United States Department of Agriculture-Veterinary Services, 2017.

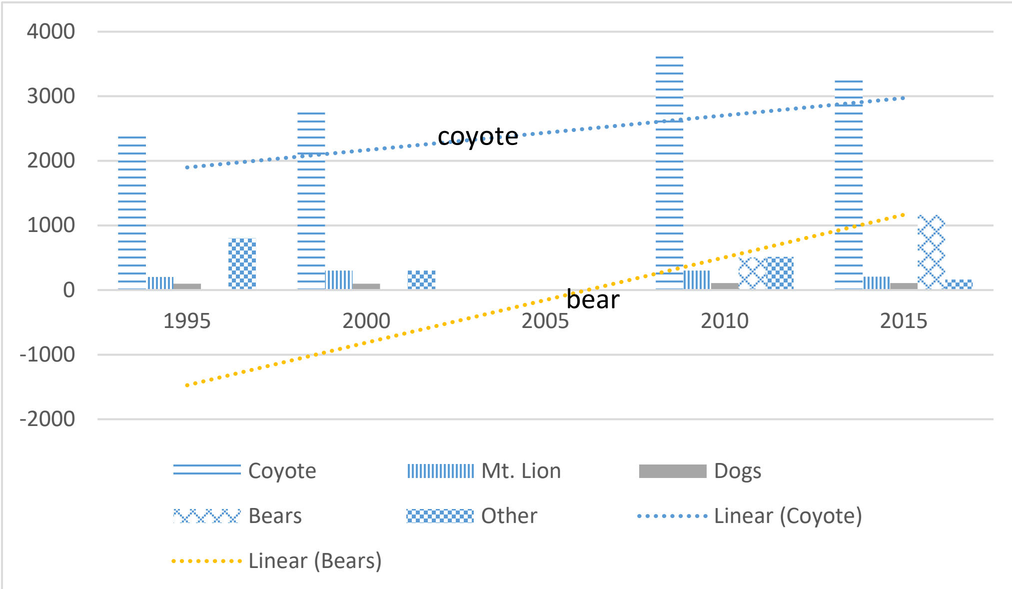

Figure 1-3. Number of cattle and calves combined killed by predators in Colorado. State specific data for 2005 unavailable. Data from National Agricultural Statistics Service and United States Department of Agriculture-Veterinary Services, 2017..

The reported losses (VS 2017) and compensation claims (Figures 1-4 and 1-5) are widely disparate for black bears. In 2015, Colorado cattle producers reported to NASS (2017) that 174 cattle and 966 calves were killed by black bears, but compensation claims were only submitted for 28 or 2% of those losses. This can be partly explained by the stringent CPW verification of losses, which is often not achievable for cattle losses, as discussed above. Additionally, cattle producers are less aware of the CPW compensation program, which might explain some of the disparity. This disparity underscores the unverified nature of the producer-reported data in the NASS reports. Whether some of the disparity might be due to exaggerated loss reporting, or un-verifiable assumptions about the cause of the loss, is unknown.

Sheep producers were very aware of the availability of the CPW compensation program for losses due to black bear predation, and the disparity between NASS data and CPW compensation claims is much less pronounced. In 2014, Colorado sheep producers reported to NASS (2015) that 1,900 adult sheep and 1,391 lambs were killed by black bears, and compensation claims were submitted to CPW for 1,619 or 49% of those reported losses. This disparity can be explained by the failure to report losses which might be too old to meet the stringent requirements for compensation. The apparent gap between sheep claims submitted to CPW (~1,200; Figure 1-5) and claims actually paid (~60; Figure 1-4) is because each claim includes approximately 20 sheep.

Cougar predation is lower than that of coyotes, but cougars can occasionally be responsible for large sheep and lamb loss events, sometimes called "*surplus killing*." This occurs when a single predator, for unknown reasons, only consumes selected tissues or parts of many animals or the carcasses are not fed on at all (Shaw 1987). Cougars may also frighten an entire flock of sheep as they attack, resulting in a mass stampede, which sometimes results in many animals suffocating as they pile up on top of each other in a confined area, such as along the bottom of a drainage or in corrals. Cougars are at times overlooked as livestock predators because black bears take carcasses causing cougars to leave. In these situations black bears are incorrectly reported as the predator.

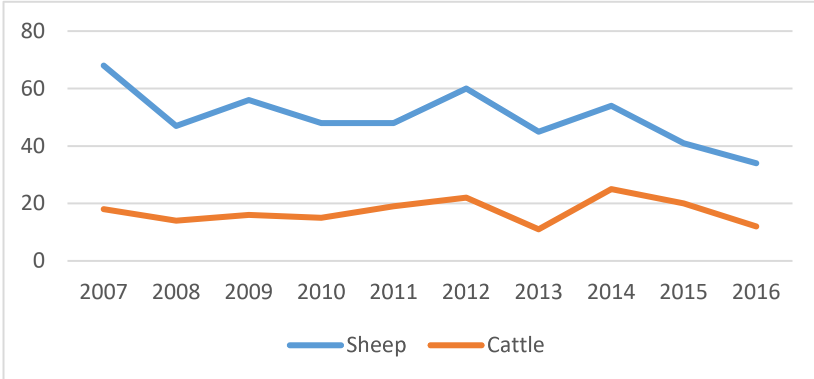

Figure 1-4. Number of claims paid for resources predated by black bears in Colorado as reported to Colorado Parks and Wildlife.

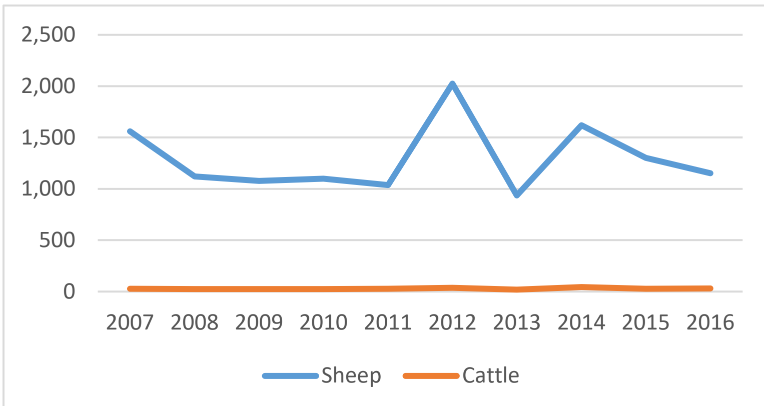

Figure 1-5. Number of livestock depredated by black bear in Colorado for which compensation claims were submitted to Colorado Parks and Wildlife.

These losses occurred in spite of PDM efforts by producers, who must bear the additional costs for these activities (Jahnke *et al.* 1987), and the efforts of WS-Colorado personnel.

1.17.2.6 What are livestock producers doing to prevent predation?

NASS statewide and national damage surveys reported preventative measures used by producers, including fencing, hazing, guarding, and other methods (NASS 2011, 2015). Table 1-7 shows the percentage of producers surveyed that used non-lethal strategies to prevent losses of cattle, calves, (NASS 2011) and sheep (NASS 2015) from predators in Colorado. The number of sheep producers using guard dogs has more than doubled from 1999 to 2014 (NASS 2000, 2015). Culling refers to the removal of older and more vulnerable livestock from the inventory.

WS-Colorado is typically contacted by landowners who have attempted several non-lethal strategies on their own. After receiving a request for assistance, WS-Colorado assesses the situation to determine if the non-lethal methods previously conducted by the landowner were appropriate and carried out correctly, given the circumstances. Additional non-lethal methods may be recommended and or implemented by WS-Colorado if deemed potentially effective by field personnel; sometimes, however, resolution of the conflict requires supplemental lethal control.

Appendix A provides more detail on both non-lethal and lethal PDM methods.

Table 1-7. Percentage of Colorado Livestock Operations Utilizing a Specific Non-lethal Method for Protection of Cattle & Calves or Sheep. (Producers can utilize more than one non-lethal method simultaneously; NASS 2011, 2012, 2015).

	Resource Protected	
Non-lethal Method	Cattle and Calves	Sheep and Lambs
Guard dogs	3%	51%
Exclusion fencing	3%	61%
Frequent checks	4%	23%
Carcass removal	2%	13%
Culling	2%	22%
Night penning	3%	47%
Herding	<1%	14%
Fright/harassment tactics	<1%	6%
Shed lambing	-	44%
Llamas	-	14%
Changing bedding	-	10%
Donkeys	-	5%
Other	2%	2%

1.17.2.7 What Diseases Do Predators Transmit to Livestock in Colorado?

In addition to direct livestock losses to predators through predation and injury, livestock can also be impacted by a number of diseases transmissible from predators. Not all of these pathogens have documented detections in Colorado predator populations. However, since these pathogens are known to circulate in predator populations outside of Colorado, it is possible that some pathogens may be undetected in Colorado predator populations or may be introduced to those populations in the future. Predator management can have an indirect effect by reducing the risk of livestock contracting a disease by minimizing the potential for livestock-predator interactions. Transmittable diseases include the rabies virus (raccoons, skunks, foxes, coyotes); leptospirosis (canines, raccoons, opossums); *Neospora caninum* (feral dogs, coyotes, and fox); *Toxoplasma gondii* (domestic cats) (Adler and Moctezuma 2010, CDC 2011, McAllister 2014); and others. WS-Colorado has not been requested to conduct PDM specifically for livestock disease control, but PDM activities for other reasons can indirectly assist disease control efforts.

1.17.2.8 What is the Wildlife Services-Colorado predator damage management program and how does it provide service?

WS-Colorado responds to wildlife damage complaints from cooperators ranging from private citizens to other agencies. WS-Colorado recorded damage losses caused by 10 predator species during FY12-16 (Table 1-3). The biggest portion of the WS-Colorado program is to resolve conflicts between coyotes and livestock and this is reflected in the amount of losses that WS-Colorado recorded.

WS-Colorado conducts PDM in cooperation with several other agencies in Colorado. CDA is a primary cooperator with WS-Colorado for predators because they have the authority to establish cooperative programs with WS and counties in Colorado. WS-Colorado and CDA have an MOU which lists responsibilities and authorities as they relate to PDM. Under the MOU, WS-Colorado has the authority to respond to all damage requests involving agricultural endeavors from predators. CPW has management authority over predators causing damage to non-agricultural property or when they are considered nuisance animals. CPW issues depredation permits to take big game and furbearers and documents the use of restricted methods such as foothold traps and snares under 30-day permits on private lands. WS-Colorado acts as an agent for entities requesting assistance with agricultural depredations and for private individuals that request assistance in reducing damage to private property. The Colorado Department of Public Health and Environment has management authority over predators when they are impacting human health and safety and prohibited methods are needed to resolve a particular problem. WS-Colorado cooperates and acts upon requests from the Colorado Department of Public Health and Environment when necessary.

WS-Colorado is a cooperatively funded, service-oriented program. Cooperators range from private citizens to other agency personnel. Besides the state agencies, WS-Colorado also cooperates with many counties in Colorado and focuses most PDM efforts in these areas where funding allows for staffing. WS-Colorado generally conducts limited work in non-cooperating counties, but may consider more projects as funding becomes available from interested governmental agencies and private individuals.

Colorado encompasses about 104,000 mi^2 (66,635,566 acres) in 64 Counties (Figure 1-6). The human population has grown from 1.75 million citizens in 1960 to 5.4 million citizens in 2015 making Colorado the second fastest growing state (Murphy 2016, Census Scope 2001). The growth in the human population and many wildlife species had led to increased conflicts and requests to protect agriculture, natural resources, property and human health and safety. The range in values and attitudes towards wildlife has also diversified leading to many different opinions about how best to resolve wildlife conflicts.

The mission of the WS program nationally and in Colorado is to provide leadership to protect resources from wildlife damage and conflict. The WS-Colorado program is divided into three geographic Districts: West Slope (northwestern Colorado), Northeast (Front Range and northeastern Colorado), and Southern (southern and southeastern Colorado). WS-Colorado receives requests for PDM throughout Colorado. At a minimum, all requesters are provided with technical assistance (self-help information). Operational assistance is primarily provided in the counties that are shaded in Figure 1-6; however, assistance may be provided anywhere in Colorado where a need exists and funding is available to cover such actions.

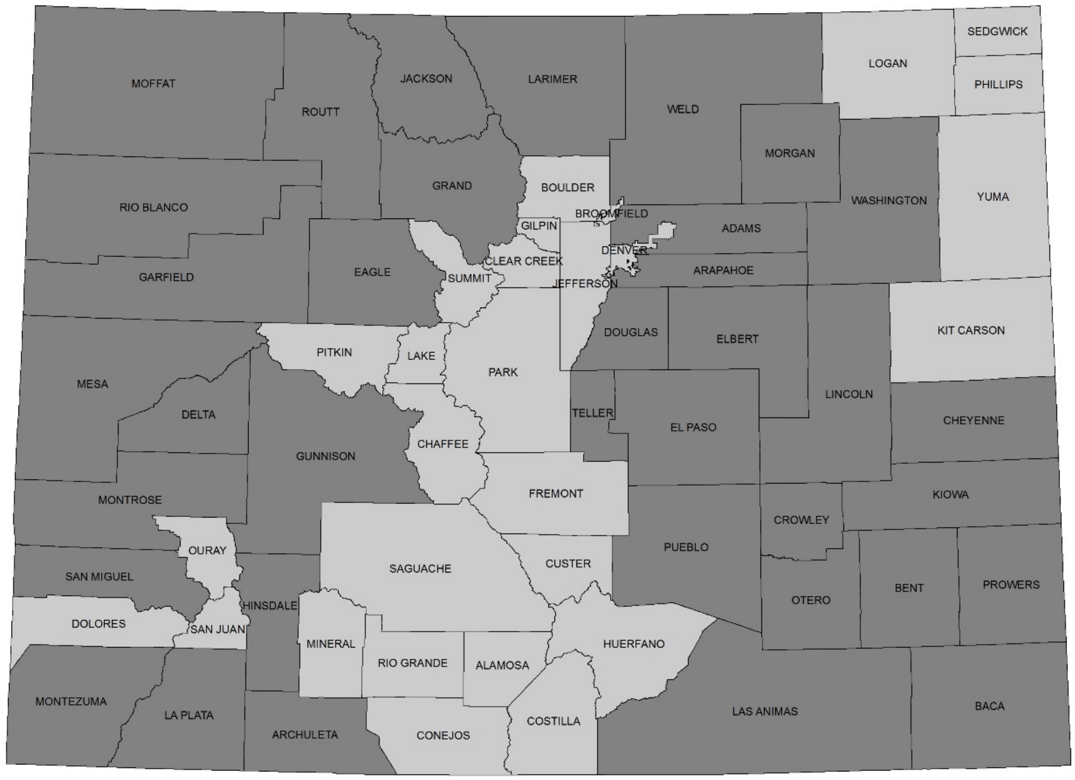

Figure 1-6. Counties (shaded dark gray) in Colorado where Wildlife Services-Colorado has provided services to reduce predation on livestock from coyotes, black bears, mountain lions and red fox from Federal Fiscal Year 2010 to 2014.

1.17.3 What is the Need for PDM in Colorado for Protecting Agriculture Resources and Property Other Than Livestock?

Several other agricultural commodities can be damaged by predators such as beehives, haystacks, aquaculture, livestock feed, eggs, and irrigation systems. During FY12-16, most of this type of damage has been sporadic, and most has involved black bears and raccoons. Red fox also caused some damage. WS-Colorado recorded an average of $2,892 in annual losses to these resources due to predators (Table 1-3). This only includes those losses reported to WS-Colorado; not all losses are reported to WS-Colorado. Several other species can be responsible for these types of damage, but such damages were not recorded by WS-Colorado in FY12-16. Although the recorded average annual losses may seem insignificant, the losses to the individuals experiencing the damage may be substantial.

1.17.4 What is the Need in Colorado for Protection of Public Safety, Health, and Pets from Predators?

WS-Colorado conducts some PDM in Colorado to reduce human health and safety concerns for the public. Human health and safety concerns include: human attacks from mountain lions, black bears, and coyotes that result in injuries or death; disease threats (*e.g.*, rabies and plague outbreaks) where predators act as reservoirs; odor and noise from skunks, opossums, and raccoons in attics and under houses; and aircraft strike hazards from coyotes and red fox crossing runways at airports or airbases.

Of the threats that predators pose to public health and safety, attacks on people by large predators are one of the biggest. Fortunately, these are rare. Still, mountain lion attacks on humans in the western U.S. and Canada, have increased markedly in recent decades, primarily due to increased lion populations and human use of lion habitats (Beier 1991). No lion-caused fatalities have been documented in Colorado during FY12-16, but they have occurred in prior years.

Coyotes can also be a threat to human safety, as discussed below. WS-Colorado assists many residents, especially in urban areas such as the Denver metropolitan area, concerned about coyote attacks on their pets. Predator attacks on humans fortunately occur rarely. During FY12-16, WS-Colorado responded to incidents involving people attacked and/or injured by mountain lions (one incident) and black bears (six incidents). WS-Colorado has also responded to numerous complaints involving coyotes, mountain lions, and black bears which were perceived as threats to public safety, where no attacks were documented. WS-Colorado might recommend exclusion and/or harassment methods to reduce human health and safety concerns, but the offending animals are often removed, especially when dealing with bold or aggressive coyotes and larger predators. Research suggests that the removal of these individual offending animals is sometimes the best way to solve the problem (Baker 2007, Breck *et al.* 2017).

1.17.4.1 What is the Potential for Risk to Human and Pet Health and Safety from Predators?

As wildlife adapts to using human-altered habitats and societal views have led humans to ignore and in some ways encourage wildlife to live within our midst, many animals have lost their fear of people and become habituated to people, vehicles, and developed areas. With their natural fear of humans gone, some individual animals may exhibit bold and even dominant behavior toward humans. If people respond by backing away, the animal becomes further emboldened. Animal behavior may then either appear to be or actually become aggressive, with aggressive posturing, a general lack of caution toward people, and/or other abnormal behavior. In addition to habituation, disease may also cause these behaviors, resulting in calls for assistance. Overall, attacks by wildlife on people are very rare in Colorado and nationwide.

Pets and zoo animals are occasionally killed by predators. This can be more common in suburban areas where coyotes, foxes, and other generalist predators adapt well and flourish in the new habitat provided by humans. Coyotes have long been known for their adaptability and ability to thrive in suburban neighborhoods. They are especially aggressive towards dogs during the breeding season and will attack and kill them, even those being walked on a leash. Deer often feed in these environments, attracting mountain lions, which will also take pets. These species become accustomed to human smells and, over time, can lose much of their fear of humans. During FY12-16, WS-Colorado documented $4,260 in annual losses to pets and zoo animals due to predators. Most of these economic losses were caused by mountain lions and coyotes. Some incidents, involving zoo animals for example, result in much higher losses than others (Table 1-3).

1.17.4.2 What is the Extent of Human-Coyote Interactions?

After more than 30 years of investigating, Baker and Timm (2017) concluded that urban and suburban coyote conflicts are continuing to increase as coyotes adapt to living in proximity to people. Whereas coyote attacks on people are rare, the attack can be traumatic, especially for pet owners who may view pets as family members (Baker and Timm 2017). Poessel *et al.* (2013) stated the data suggests coyotes pose a minor risk to human health and safety. Several wildlife scientists have investigated coyote attacks on people and pets in urban and suburban environments to better understand occurrence of these events (Poessel *et al.* 2013, Gese *et al.*

2012, White and Gehrt 2009). These investigations looked at causes of coyote attacks on humans and pets. Whereas most coyotes can live in proximity to people with no conflicts (Gehrt *et al.* 2009), a small minority of coyotes display overly bold and aggressive behavior (Breck *et al.* 2017).

Baker and Timm (2017) documented 367 coyote attacks on humans from coyotes from 1977 to 2015. They examined the attacks to understand changes in coyote behavior. Baker and Timm (2017) found that 60% of victims were adults and 40% of victims were children 10 years of age or younger. White and Gehrt (2009) reported most coyote attacks were to children, especially predatory attacks. Children (especially toddlers) are at the greatest risk of serious injury (Baker and Timm 2017). Baker and Timm (2017) reported coyote attacks were seasonal and occurred mostly during coyote breeding and pup-rearing times of the year. Poessel *et al.* (2013) also reported most coyote attacks on people occur during coyote breeding in metropolitan Denver. White and Gehrt (2009) reported most coyote attacks on people (45%) occur during pup-rearing in metropolitan Chicago. White and Gehrt (2009) classified coyote attacks on people based on the behavior of the coyote. They found 37% of the attacks on people were predatory, 22% investigative, 6% pet related and 4% defensive. In 7% of the cases, the coyote was rabid. The remaining cases were classified as unknown. About half the victims were engaged in an outdoor recreational activity when attacked by the coyote.

Coyotes are opportunists that consume food in the proportion available (Santana and Armstrong 2017). Several investigators noted that anthropogenic food resources seem to play a role in human – coyote interactions and attacks (Baker and Timm 2017, White and Gehrt 2009). Some of the same investigators reported on the role pets may play in coyote attacks on humans (Poessel *et al.* 2013, White and Gehrt 2009). Poessel *et al.* (2013) reported 92% (471 incidents) of coyote conflicts in Denver involved pets. Baker and Timm (2017) noted the growing incidence of attacks on pets by coyotes and how this may be a precursor to attacks on people. Baker and Timm (2017) stated when behaviors such as chasing or taking pets in daylight, attacking pets on leashes or near owners, chasing joggers or cyclist occurs, then it is prudent to remove those coyotes before a human safety incident occurs.

Several investigators noted a need to standardize reporting of coyote attacks on people to better understand the behavior (Poessel *et al.* 2013, White and Gehrt 2009). With this in mind, Denver developed a citizen based hazing program for urban coyotes to reduce human – coyote conflicts (Bonnell and Breck 2017). The program taught the public to haze coyotes to reduce conflicts. The coyote response to hazing events was recorded, and the most common outcome from hazing was that the coyote left the area. However, when domestic dogs were present, hazing was less effective at dispersing coyotes. Bonnell and Breck (2017) reported that community level hazing can be an effective short-term tool to establish a safety buffer during a negative coyote encounter. Expectations need to be set for residents, because highly visible coyotes may not leave the area from hazing. Breck *et al.* (2017) also evaluated pro-active and reactive non-lethal hazing and concluded reactive non-lethal hazing is ineffective, whereas pro-active hazing was effective. They also concluded that removal of problem individual coyotes was an effective means of resolving the coyote-human conflict, and found that 1-2% of the coyote population in metropolitan Denver had to be removed to resolve coyote – human conflicts. The results of a removal was no recurrence of coyote – human conflicts for an average of 3 years in that location.

1.17.4.3 What is the Extent of Human-Black Bear Interactions?

At least 63 people have been killed by non-captive black bears between 1900 and 2009, mostly in Alaska and Canada (49 fatal encounters), with 14 fatal encounters in the lower 48 states. In

38% of the incidents, the presence of food or garbage probably influenced the bear being in the location. Most fatal predatory incidents involved adults or subadult male bears, indicating the female bears with young are not the most dangerous bears (Herrero *et al.* 2011).

Black bears may easily adapt to living in close proximity to humans, especially with the presence of subsidized food, and may lose their fear of humans. Most threatening conflicts with bears in Colorado occur in rural and urban residential areas and recreational areas such as campgrounds involving the presence of easy human-provided food, typically garbage cans, bird feeders, feed storage sheds, or food kept in automobiles (Herrero and Fleck 1990). Access to readily available and nutrient dense human foods may almost double the reproductive potential of black bears (Rogers 1987).

During FY12-16, WS-Colorado Specialists responded to 19 instances of black bear attacks or aggression towards humans in Colorado. These included 8 verified attacks, some with significant injuries. Fortunately, there were no human fatalities due to bears during this timeframe. The last known fatality was in 2009 in Ouray County.

1.17.4.4 What is the Extent of Human-Cougar Interactions?

Potential dangerous cougar behaviors include aggressive actions such as charging or snarling, or loss of wariness of humans as displayed by reported sightings during the day in areas with permanent structures used by humans. From 2011 to 2013, cougar attacks on people in the western United States and Canada have increased in the last two decades, primarily due to increasing lion populations, human use of lion habitats, and habituation to people (Beier 1991, Cougar Management Guidelines Working Group 2005). Fitzhugh *et al.* (2003) report there were 16 fatal and 92 non-fatal attacks on humans since 1890 in the United States and Canada but of those, seven fatal and 38 non-fatal attacks occurred since 1991. For example, since California's Wildlife Protection Act of 1990 (Proposition 117; California Fish and Game Code, Division 3, Chapter 9, Sections 2780-2799.6) gave mountain lions special status in the state resulting in a prohibition on regulated hunting, there have been three fatal and ten nonfatal attacks verified by California Department of Fish and Wildlife (CDFW 2017).

WS-Colorado Specialists responded to 10 human incidents involving mountain lions during FY12-16, including 1 non-fatal attack involving 2 mountain lions attacking 2 people in Eagle County in 2016.

1.17.4.5 What is the Potential for Disease Transmission to Humans and Pets?

Zoonoses (*i.e.*, wildlife diseases transmissible to people) are a major concern of cooperators when requesting assistance with managing threats from mammals. Pathogen transmission occurs through direct contact between infected and uninfected hosts, including host contact with a pathogen-contaminated environment or food product. Indirect transmission of pathogens, such as through an intermediate host or vector species such as mosquitos and biting flies, is another possible transmission pathway. Once a pathogen transmits to a new host species, such as livestock or pets, secondary cases of infection to the rest of the herd or humans can occur. Pets and livestock often encounter and interact with wild mammals, which can increase the opportunity of transmission of pathogens to humans. Diseases of wildlife, livestock, pets, and humans can be caused by viral, bacterial, or parasitic pathogen species.

1.17.4.6 What Work is Needed to Protect Air Operations from Ground Predators at Colorado Airports?

Airports provide ideal conditions for many mammalian wildlife species due to the large open grassy areas adjacent to brushy, forested habitat used as noise barriers and often being adjacent to water. Access to most airport properties is restricted, so predators living within airport boundaries are not harvestable during hunting and trapping seasons and are insulated from many other human disturbances.

The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon *et al.* 2001, Dolbeer 2009). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1998), result in lost revenue, and repairs to aircraft can be costly (Linnell *et al.* 1996, Robinson 1996, Thorpe 1998, Keirn *et al.* 2010). Aircraft collisions with wildlife can also erode public confidence in the air transport industry as a whole (Conover *et al.* 1995).

Between 1990 and 2014, there were 3,360 reported aircraft strikes involving 41 species of terrestrial mammals in the United States (Dolbeer *et al.* 2015). The number of mammal strikes actually occurring is likely to be greater even though strike reporting at General Aviation airports has increased 58% from 2010 to 2014. Species of terrestrial mammals struck by aircraft in the United States from 1990 through 2014, including raccoons, fox, cats, coyotes, artiodactyls (*i.e.* deer), opossums, dogs, and skunks (Dolbeer *et al.* 2014). Of the reports of terrestrial mammals struck by aircraft, 36% were carnivores (primarily coyotes), causing over $4 million in damages (Dolbeer *et al.* 2014). Aircraft striking coyotes have resulted in 14,135 hours of aircraft downtime and nearly $3.7 million in damages to aircraft in the United States since 1990 (Dolbeer *et al.* 2014). Aircraft strikes involving dogs have caused over $400,700 in damage in the United States since 1990 (Dolbeer *et al.* 2014).

In addition to direct damage, an aircraft striking a mammal can pose serious threats to human safety if the damage from the strike causes a catastrophic failure of the aircraft leading to a crash. For example, damage to the landing gear during the landing roll and/or takeoff run can cause a loss of control of the aircraft, causing additional damage to the aircraft and increasing the threat to human safety. Nearly 64% of the reported mammal strikes from 1990 through 2014 occurred at night, with 89% occurring during the landing roll or the takeoff run (Dolbeer *et al.* 2014).

Wildlife populations of terrestrial mammals near or found confined within perimeter fences at airports can be a threat to human safety and cause damage to property when struck by aircraft. Those wildlife confined inside an airport perimeter fence would not be considered distinct populations nor separate from those populations found outside the perimeter fence. Wildlife found within the boundaries of perimeter fences originate from populations outside the fence. Those individuals of a species inside the fence neither exhibit nor have unique characteristics from those individuals of the same species that occur outside the fence; therefore, those individuals of a species confined inside an airport perimeter fence do not warrant consideration as a unique population under this analysis.

1.17.5 What Is the Need for WS-Colorado Assistance to CPW, USFWS and others for Natural Resources Protection?

Predators are sometimes responsible for damage to natural resources, including T&E, sensitive, and game species. During FY12-16, WS-Colorado responded to an annual average of 86 incidents of predator damage or threats to natural resources. Most of these responses (92%) were to protect federally threatened Gunnison sage-grouse from predation by coyotes and other predators. WS-Colorado also responded to requests to protect federally threatened piping plovers and federally endangered black-footed ferrets from predation by coyotes.

WS-Colorado responded to requests to protect mule deer from predation by black bears, black-footed ferrets from predation by coyotes, and Gunnison sage-grouse from predation by coyotes and ravens. WS-Colorado is responsive to agencies with management responsibilities for wildlife species that are impacted by predation. PDM for wildlife protection can be very effective when predation has been identified as a limiting factor. WS-Colorado works with these agencies to identify and provide the level of PDM needed. When such actions are requested by USFWS or another Federal agency, the responsibility for NEPA compliance rests with that agency. However, WS-Colorado could agree to take on the responsibility for NEPA compliance at the request of the other Federal agency.

1.17.5.1 Predator – Prey Relationships Involving Wildlife.

Prey selection by predators is a complex subject, influenced by predation strategies (*e.g.*, coursing versus ambush predators) and many other factors. Prey selection is a complex subject, and should not be over-simplified. Many scientists believe that predators selectively prey on vulnerable individuals. Such selective predation has much scientific support. Individual prey animals might be more vulnerable due to age (young or old), injury, infection, body condition, environmental conditions (*e.g.*, heavy snow), habitat, location (*e.g.*, separated from the herd or no escape route), or many other factors. Many commenters have suggested that predators selectively prey on diseased animals. This is supported by science for some predators (for example, mountain lions; see Miller *et al.* 2008, Krumm *et al.* 2010), but it is only part of the story. Many other intrinsic and extrinsic factors can make a prey animal susceptible to predation, as noted above. In addition, selective predation is not universal; some predators have been shown to hunt opportunistically, without any apparent selection pattern (for example, Novaro *et al.* 2000). Some researchers have found evidence of selection for apparently healthy adult prey animals (Anderson and Lindzey 2003).

Predator-prey studies assess the effects of age-specific survival on population growth, and possible interactions between predation, forage availability (*i.e.* nutrition), and weather (Forrester and Wittmer 2013). Determining if predation, nutrition, weather or other factors are limiting growth of a population is complex. Monteith *et al.* (2014) summarized that evidence of mortality is often used to justify predator management to increase ungulate (hoofed mammal, *e.g.*, deer) populations which underscores the need to correctly interpret the causes and consequences of mortality. Factors limiting growth of ungulate populations are numerous, interacting, and subject to variability (Bishop *et al.* 2009) (Table 1-8). Early debates about ungulate populations were based on competing hypotheses of population effects caused by food limitations and predation (Peek 1980). It is now recognized, as the base of knowledge has grown from further research, that food limitations and predation simultaneously affect ungulate population dynamics (Sinclair and Krebs 2002). Further, the interactions between nutrition and predation are likely mediated by weather (Hopcraft *et al.* 2010). That being said, predation can affect a prey population only if predation mortality is at least partially additive to mortality from other causes (Fryxell *et al.* 2014). Multiple studies have identified three conditions that must be met to determine that predators are effecting an ungulate population: 1) the ungulate population is below carrying capacity, 2) mortality is a primary factor influencing change in prey abundance and 3) predation is the major cause of mortality (Forrester and Wittmer 2013, Hurley *et al.* 2011, Theberge and Gauthier 1985).

Determining the role of predation in shaping the growth of a local ungulate population is complex due to the interaction of environmental variables that influence potential population growth rate and density (Hurley *et al.* 2011). Moreover, determining if mortality is additive or compensatory, the role of alternate prey, whether the predator prey interactions are influenced by multiple predators or multiple prey species, and whether the cause of mortality is proximate or ultimate complicates agency decision making, and understanding by the public.

Additive mortality is that which increases the overall mortality, but does not cause a reduction in other forms of mortality. Compensatory mortality is that which causes a reduction in other forms of mortality, such that overall mortality is not increased (Bartmann *et al.* 1992).

Predation mortality and malnutrition/disease mortality are often the largest causes of death in ungulate populations, especially mule deer (Forrester and Wittmer 2013, Hurley *et al.* 2011, Bishop *et al.* 2009). Predation was the largest proximate cause of mortality in both adult female and fawn mule deer in all studies reviewed by Forrester and Wittmer (2013). However, many of these studies found mortality was compensatory, and other forms of mortality (*i.e.*, nutrition, weather) were the ultimate cause of death (Forrester and Wittmer 2013). Determining if predation was the primary factor causing a population decline, and the ultimate cause of death, is even more complicated in multiple predator, multiple prey systems (Lehman *et al.* 2018, Leblond *et al.* 2016, Latham *et al.* 2013). Monteith *et al.* (2014) proposed a methodology requiring a short-term research project to determine if predation or nutrition were the cause of mule deer population declines; in other words, whether predation mortality was additive or compensatory. Bishop *et al.* (2009) reached a similar conclusion about determining if mortality was additive or compensatory. But interactions are complex, and thus data are difficult to interpret. Hurley *et al.* (2011) found evidence of compensatory mortality from coyotes, and inconsistent effects of predator management on mule population metrics. They also found decreased mortality of 6-month old fawns and adult does with increased lion removal, which could lead readers to conclude predator management had a benefit. However, the magnitude and frequency of weather-caused mortality overwhelmed the effects of predator-caused mortality. They found that the greatest potential for population growth was likely from improving habitat to improve nutrition for mule deer. Hurley *et al.* (2011) postulated that coyote removal may increase deer populations, but this was contingent on lagomorph and small mammal population levels measured in April.

Managing ungulate populations requires wildlife agencies to examine many factors to understand why a population may have declined (Table 1-8) and to guide management efforts to increase a population (Boertje *et al.* 2017). Populations can be affected by climate variation, predation, habitat (nutrition), and/or the relationship to carrying capacity (Boertje *et al.* 2017, Bishop *et al.* 2009). Whereas wildlife and land management agencies can manipulate predation or habitat to attempt to reach population management goals, climate and weather operate independently of agency actions.

1.17.5.2 Mule Deer Populations in the West.

WS-Colorado has been requested to reduce predation on several ungulate species over the years. Mule deer are the species WS-Colorado would most likely be requested by state or federal wildlife management agencies to protect from predation, if predation was determined to be limiting population maintenance or growth. Mule deer populations have historically exhibited volatile population fluctuations in the western United States (Unsworth *et al.* 1999, Peek *et al.* 2002). The history of mule deer populations can be characterized by gradual population increases in the 1920's, peaking in the 1940's to early 1960's and then declining in the late 1960's to mid- 1970's. Mule deer populations then exhibited growth in the 1980's followed by decline in the 1990's in some areas of the west (Denny 1976). A complex combination of factors influence these population fluctuations including climate, habitat changes, predation, competition with other herbivores, and interactions among factors, as discussed above (Forrester and Wittmer 2013, Hurley *et al.* 2011, Ballard *et al.* 2001).

Table 1-8. Variables and factors that wildlife agencies consider when evaluating the decline or increase of a mule deer population. Variables are dynamic, interact with each other, and change annually.

Variable	Proximate factor	Ultimate factor
Coyote predation	Lagomorph (*e.g.* rabbit) density Microtine (*e.g.* vole, mice) density	Previous year's summer rainfall affects lagomorph and microtine density
	Lagomorph and coyote populations are highly synchronized	In dry years coyotes depredate more deer fawns than expected In wet years coyotes may exclusively depredate lagomorphs
Mule deer fawn survival	Doe body condition contributes to fawn body mass and survival	Previous summer rainfall influences fat deposits and body condition of doe
	Highly variable, unpredictable fawn survival to $\geq$ 7 months age	Coyote predation in first month of life Summer rainfall in current year Julian calendar date of birth Body weight at birth Early summer rains cause death from exposure Disease Age of doe or senescence
	Quality of summer range (nutrition)	Age and diversity of plant species
	Yearling survival (Jan. – April)	Winter snowfall Late summer and fall rains Lion predation (additive or compensatory) Coyote predation (additive or compensatory) Disease
Adult doe mule deer survival	Quality of summer range	Age and diversity of plant species Quantity and timing of precipitation
	Quality of winter range	Age and diversity of plant species Timing and quantity of winter precipitation
	Pregnancy rate, fetus and neonate survival	Previous summers precipitation Timing and quantity of winter precipitation Body condition to survive birth and lactation Nutrition of fawning habitat Doe age and physical condition
Lion predation	Additive or compensatory mortality Doe physical condition and fat reserves	Winter weather Previous summer precipitation Malnutrition or disease
Bear predation	Quality of fawning habitat	Increased bear population Disease Habitat fragmentation

Mule deer populations are defined by various adult doe and fawn parameters, because these have the greatest influence on population response. Mule deer have lower and more variable fawn survival than other ungulate species, whereas adult doe survival appears high and stable throughout the geographic range of the species. Adult doe survival was an important secondary factor for changes in population growth. Observed low fawn survival appears to be compensated for by high fecundity. Local snowfall has a large impact on overwinter fawn survival. Predation is the primary proximate cause of mortality for all age classes. In addition, predation is an important source of summer fawn mortality. In multiple prey - multiple predator systems, predation is an important source of mule deer mortality. Predation is generally compensatory, especially in populations near or at carrying capacity. Lastly, nutrition and weather shape population dynamics (Forrester and Wittmer 2013).

1.17.5.3 Effectiveness of PDM in Managing Mule Deer Populations.

Forrester and Wittmer (2013) reviewed a number of experimental studies on the effects of predator control to manage mule deer populations. The results of these studies were variable, which limits our understanding of the influence of predation on mule deer populations. The conclusions from these studies were that coyote removal generally had no effect on mule deer populations, and mountain lion and coyote predation was compensatory rather than additive, with possibly one study being additive. Wolf predation was found to be additive in the one mule deer study reviewed. But the studies were predominately from high density mule deer populations relative to nutritional carrying capacity, so these conclusions may only be applicable to such high density populations (Forrester and Wittmer 2013, Ballard *et al.* 2001). Moreover, Forrester and Wittmer's (2013) review only found 6 studies which reported vital rates for the mule deer populations after predators were removed.

Ballard *et al.* (2001) reviewed mule deer – predator relationships, and found predation by coyotes, mountain lions, and wolves may be significant mortality factors under some conditions. They determined that predation could only be identified as a major limiting factor for ungulate populations through manipulative studies. Where predators were identified as a major limiting factor, deer populations were well below forage carrying capacity, and study areas generally were small (< 180 km^2). Their review of 16 studies to examine predation on mule deer determined that 8 had additive mortality from coyote, lion, and wolf predation, and one had additive and compensatory mortality from coyote predation. Ballard *et al.* (2001) found empirical evidence for PDM to increase moose, caribou, and black-tailed deer populations. The challenges that Ballard *et al.* (2001) reported in determining whether predation on mule deer was additive were: (1) short duration of most studies, (2) weather patterns, and (3) variation in habitat carrying capacity. Also, many studies were silent as to whether predation limits or regulates the deer population (Ballard *et al.* 2001).

Ballard *et al.* (2001) concluded that removal of major predators, livestock grazing, competition with livestock and other wild ungulates, fragmentation of habitats, and other human influences alter relationships among predators, habitat, weather, and harvest by humans. Leblond *et al.* (2016), Laliberte and Ripple (2004) and Forrester and Wittmer (2013) expressed similar concerns about how relationships among predators and other factors have been altered by man.

Forrester and Wittmer (2013) noted two exceptions to the pattern of compensatory predator mortality where summer fawn mortality and predation in multiple predator, multiple prey systems. Predation plays a larger role in multiple predator, multiple prey systems that experience large and recent changes in predator or alternative prey populations (Hatter and Janz 1994, Robinson *et al.* 2002, Cooley *et al.* 2008). Recently, Latham *et al.* (2013) and Leblond *et al.* (2016) demonstrated how man altered the natural environment which caused predation to suppress and prevent recovery of the prey species. Latham *et al.* (2013) reported white-tailed deer (*Odocoileus virginianus*) extended their range into new habitat in Alberta and concomitantly increased in abundance 17-fold since the 1990's resulting in an alternative prey that nearly doubled the local gray wolf population resulting in increased predation on woodland caribou (*Rangifer tarandus caribou*). Caribou naturally had spatial separation from gray wolves during calving and summer. Now, the occurrence of white-tailed deer has provided an additional summer food source to beaver, and gray wolves no longer have spatial summer separation from caribou resulting in new and increased mortality and caribou population decline. Leblond *et al.* (2016) also studied predation on woodland caribou by gray wolves and black bears in a human altered environment in Quebec. The environment was largely altered by timber harvest, roads, which fragmented the habitat to the benefit of black bears. Caribou are a predator avoidance specialist unable to adjust to a now abundant predator (*i.e.* black bears) which became abundant via new rich food resources caused by timber harvest. Black bear predation on calves represents 94% of all mortality in the human altered landscape and prevents recovery of woodland caribou (Leblond *et al.* 2016). Both studies are examples of additive mortality affecting an ungulate population's growth. A similar study by Eacker *et al.* (2016) looked at elk calf survival in a multi-predator system with mountain lions, wolves and black bears and concluded juvenile recruitment into the population may depend on the carnivore assemblage as well as compensation from weather and forage. In this study, mountain lions had constant predation pressure on elk calves regardless of forage availability or weather severity indicating predation was additive. A black bear predation study on caribou in Newfoundland determined predation was additive causing a 66% reduction to the caribou herd over 16 years due to the temporal timing of the predation on calves (Rayl *et al.* 2015).

Forrester and Wittmer (2013) developed three feedback patterns which can be useful to classify ungulate population dynamics. The feedback patterns were developed to look at mule deer population dynamics in the ecological context of the deer population (Table 1-9). These patterns are useful to make preliminary judgments as to whether an ungulate population is subject to population declines caused ultimately by predation. Further analysis or small research projects could supplement the feedback patterns to determine if a larger scale research or management action is warranted.

A recent study by Treves *et al.* (2016) criticizes certain research on lethal PDM methods, and recommends suspension of these tools until more rigorous scientific studies prove their efficacy. The authors in this paper call for new study designs that use the same standards as those in controlled laboratory settings for biomedical research. NWRC research scientists have evaluated this paper and do not agree with the authors' assessment that existing research is flawed (WS 2016a; Appendix E). There are important differences between research studies conducted in a field environment, and studies in biomedical laboratory settings. Field research inherently brings in variables such as weather, varying habitat quality, and movement of wildlife which cannot be controlled. Assumptions must be made when trying to answer complex ecological questions in field settings. Scientists address and acknowledge this variability using well-established and recognized field study designs, such as the switch-back and paired block designs. Additionally, Treves *et al.*'s (2016) critique of at least two studies by scientists currently working for WS did not accurately interpret or represent the studies' designs or results, and this raises questions regarding potential additional misrepresentations and errors in the paper. Details on WS' review of Treves *et al.* (2016) are provided in Appendix E.

WS agrees that PDM tools and techniques must be based on rigorous, scientifically-sound principles. Researchers at NWRC are dedicated to gathering information, testing new ideas and methods, and using experiments (versus observational studies) as much as possible. WS' scientists at NWRC's Utah Field Station in particular are leaders in the design and implementation of controlled studies to evaluate predation and predator control methods. They collaborate with experts from around the world to conduct these studies and findings are published in peer-reviewed literature.

1.17.5.4 Mule deer populations in Colorado.

Colorado had a statewide mule deer population of 418,560 in 2016, which is down from approximately 600,000 deer in 2006 (CPW 2017). The 2016 estimate is lower than recent years (424,190 in 2016 and 435,660 in 2015), but higher than 2013 (about 390,000 deer), which was the lowest reported estimates in several decades (CPW 2017a; Figure 3-3). Although the most recent estimate is higher than the low in 2013, these numbers do not show a clear trend of increasing deer populations. The mule deer population is also still well below CPW's desired population target range of 560,000 (CPW 2017c). CPW manages mule deer populations in Data Analysis Units (DAUs), which represent the year-round range of a herd. Management prescriptions address unique habitat, weather, and changing environmental conditions within the unit. CPW considers harvest of male and female deer in each DAU, and adjusts harvest to reduce or restrict female hunting mortality when the goal is to increase the deer population. For western Colorado, a mule deer management strategy for the West Slope was developed after extensive public input in 2014 (CPW 2014a). The plan was developed to address declining mule deer populations on the West Slope, which are well below population objectives. The decline is atypical. CPW staff are evaluating a number of variables to understanding mule deer population decline on the West Slope including: barriers to migration, competition with elk, disease, doe harvest, declining habitat quality, habitat loss, highway mortality, predation, recreational impacts, and weather. Other populations in Colorado in the mountainous center of the state or eastern prairies may also have mule deer populations below population objectives which will need to be assessed.

CPW is following the West Slope Mule Deer Strategy to assess deer populations within DAUs. Each DAU has different variables influencing demographic performance of the deer population. The different variables result in different prescriptions to change demographic performance of the mule deer population. For example, in DAU D-9, deer-vehicle collisions were determined to be a major mortality factor. As such, CPW has worked with the Colorado Department of Transportation to install overpasses and underpasses in 2015 and 2016 to significantly reduce deer and elk collisions with motor vehicles (Bulger 2016). Similar assessments in DAU 19 and 40 determined the deer populations to be below nutritional carrying capacity, and that predation may be one factor suppressing the population. An intensive multi-year study determined that the high predation levels were actually compensatory, and that the habitat needed to be improved to increase the size of the local deer herd (Bishop *et al.* 2009).

Several concurrent studies were conducted in DAU 19 and 40 to evaluate applicability of the findings of Bishop *et al.* (2009). These studies evaluated fawn survival, body condition response, and deer density in response to habitat management. Bergman *et al.* (2014a) demonstrated habitat management increased fawn survival by 10% on units with advanced habitat treatments versus no treatments. Deer in treated areas also had higher internal body fat, which is a metric of deer health (Bergman *et al.* 2014b).

Bergman *et al.* (2015) evaluated deer density across the same two habitat treatment sites and reference sites in DAU 19 and 40. They concluded that more sensitive population parameters (*e.g.*, overwinter survival or late winter body condition) should be used in tandem with density estimates, because numerous stochastic variables (*e.g.*, winter range, transition range, weather, individual animal responses, etc.) also affect deer density.

The relationship between mule deer and predators is complex, it rarely results in simple linear relationships, and it should not be oversimplified (Mule Deer Working Group 2013). PDM to increase fecundity and population growth is complex with many variables that need to be addressed to make a determination why a population is performing below objective. With each passing decade more is learned about managing populations to achieve desired outcomes, and new challenges emerge due to changing environmental variable or actions by man. These environmental variables and actions by man require additional research to enlighten and guide management actions.

Table 1-9. Feedback patterns to assess if predation, nutrition or weather are driving ungulate population dynamics.

Feedback Pattern	Parameters	Conditions
1	a. High-density ungulate population near carrying capacity b. Nutrition interacting with weather determines population equilibrium c. Predation is primarily compensatory d. Predation, malnutrition and disease are regulating forces.	a. Pattern seen in stable food webs b. Long-term population cycles driven by nutrition from weather and habitat change c. Compensatory predation, malnutrition and disease regulate population around shifting equilibrium. d. Extreme weather events will de-stabilize population dynamics causing large and abrupt changes in survival e. Changes in survival can linger through future cohorts
2	a. Diverse predator community b. Large population of predators and prey c. Fawns limited by predation and nutrition interactions d. Adult females limited by nutrition e. Population growth constrained by fawn predation and nutritional effects on fecundity	a. Fawn survival and recruitment affected by nutrition and summer fawn predation b. Adult survival mainly affected by nutrition and possibly senescence c. Maternal condition affects birth weight and fecundity d. Complex interaction between nutrition and predation which determines recruitment and population change e. These interactions change depending on predator diversity and ungulate density f. More evidence needed on effect of bears in fawn predation
3	a. Anthropogenic changes to habitat lead to lower nutritional capacity b. Anthropogenic changes lead to large changes in predator or alternative prey populations c. Mule deer carrying capacity modified by these anthropogenic changes d. Large changes in predators or alternative prey change predation risk for primary prey e. Ungulate population likely to be de-stabilized	a. This pattern likely to exist where landscape altered by humans b. Lower nutritional carrying capacity caused by human activity c. Food webs and species composition are changed by human activity d. Mule deer are susceptible to any alteration that lowers survival of adults e. Food web and community composition and spatial distribution will be important in this pattern f. This pattern will become more common in future

Feedback patterns modeled after Forrester and Wittmer 2013.

Ballard *et al.* (2001) called for intensive radio telemetry and manipulative studies to identify if predation was a limiting factor. Monteith *et al.* (2014) called for assessments to be made to quantify the influence of predation on large ungulates by assessing the degree of compensatory or additive mortality on the nutritional capacity to young. Hurley *et al.* (2011) stated monitoring lagomorphs and small mammals in late April may provide a method to assess if coyote removal may have the possibility of success. Also, Bishop *et al.* (2009) called for additional research to determine if habitat improvements are capable of causing an increase in population growth. WS-Colorado would work with CPW, USFWS and other agencies when requested to participate in monitoring and research actions to determine appropriate management actions to meet population objectives. Some potential research projects summarized below are to evaluate management prescriptions to assess the impact of predation on mule deer populations in central and western Colorado (Appendices G and H).

1.17.5.5 What is the Potential Impact of Cougar Predation on Colorado Deer and Elk Populations?

The health of a cougar population is integrally directly linked to ungulate prey availability, distribution, and abundance (Pierce *et al.* 2000, Logan and Sweanor 2001). High cougar predation rates, especially on stressed prey populations, can reduce the size and sustainability of prey populations. Likewise, when severe winter conditions or large-scale habitat loss severely reduces local prey populations, cougars dependent on vulnerable prey may further depress or prevent prey population recovery (Neal *et al.* 1987), often resulting in cougar population declines or use of alternate prey, including other ungulates or domestic livestock (Kamler *et al.* 2002).

Throughout the western United States, deer and elk are the staple food of cougars. Numerous studies have found deer to be the primary food item of cougars even when other ungulate species such as elk, bighorn sheep, or pronghorn were present (Robinette *et al.* 1959, Ackerman *et al.* 1984, Cashman *et al.* 1992, Beier and Barrett 1993, Logan *et al.* 1996). However, in many of these studies, ungulates other than deer were not available in significant numbers. Although a variety of other species, including small mammals and birds, may be eaten, cougars do not persist in areas without ungulate prey. Cougar predation has been implicated in low elk calf survival and resultant elk population declines (Lehman *et al.* 2018, Myers *et al.* 1998).

At this time, Colorado Parks and Wildlife is conducting a study in the Upper Arkansas River drainage to determine if mountain lions are impacting a local mule deer population (Alldredge and Dreher 2016). A preliminary study conducted by CPW indicated that mountain lions may be suppressing a local mule deer population near Buena Vista (M. Alldredge, CPW, unpublished data).

1.17.5.6 How are pronghorn (*Antilocapra americana*) affected by predation?

Under certain conditions, predators, especially coyotes and mountain lions, can have a significant adverse impact on pronghorn antelope populations, and this predation is not necessarily limited to sick or inferior animals (Pimlott 1970, Bartush 1978, USFWS 1978, Trainer *et al.* 1983, Hamlin *et al.* 1984, Neff *et al.* 1985, Shaw 1977). Connolly (1978) reviewed 68 studies of predation on wild ungulate populations and concluded that in 31 cases, predation was a limiting factor.

Predation can be one of the main limiting factors for pronghorn antelope. Jones (1949) found coyote predation to be the main limiting factor for Texas pronghorns. A six-year radio telemetry study of pronghorn in western Utah showed that 83% of all fawn mortality was attributed to predators (Beale and Smith 1973). In Arizona, Arrington and Edwards (1951) showed that intensive coyote damage management was followed by an increase in pronghorn to the point where they could once again be hunted. No such increase was noted in areas without coyote damage management. Similar observations of improved pronghorn fawn survival and population increase following damage management have been reported by Riter (1941), Udy (1953), and Smith *et al.* (1986). Predation was found to be the leading cause of pronghorn antelope fawn loss, accounting for 91% of the mortalities that occurred during a 1981-82 study in southeastern Oregon (Trainer *et al.* 1983), with coyotes comprising 60% of that mortality.

In Arizona, coyote damage management on Anderson Mesa increased the pronghorn herd from 115 animals to 350 in just three years. This trend continued until coyote damage management was discontinued in 1971, peaking at 481 animals (Neff *et al.* 1985). After coyote damage management was stopped, the pronghorn fawn survival dropped to only 14 and 7 fawns per 100 does in 1973 and 1979, respectively. The land managers on Anderson Mesa then re-initiated a coyote damage management program in 1981, removing an estimated 22% of the coyote population in 1981, 28% in 1982, and 29% in 1983. By 1983, the pronghorn population on Anderson Mesa had risen to 1,008 antelope, exceeding 1,000 animals for the first time since 1960. Fawn production increased from a low of 7 fawns per 100 does in 1979 to 69 and 67 fawns per 100 does in 1982 and 1983, respectively. After a five-year study, Neff and Woolsey (1979, 1980) determined that coyote predation on pronghorn fawns was the primary factor causing fawn mortality and low pronghorn densities on Anderson Mesa. Smith *et al.* (1986) noted that controlling coyote predation on pronghorn fawns could result in 100% annual increases in population size, and that coyote removal was a cost-effective strategy in pronghorn management.

1.17.5.7 How are Bighorn Sheep (*Ovis canadensis*) affected by predation?

Bighorn sheep populations are also very susceptible to predation, especially where their populations have reached precariously low numbers (Mooring *et al.* 2004). Mountain lions are the primary predator of bighorns, but coyotes and bobcats will also take them. Mooring *et al.* (2004) found that in New Mexico, rams had the highest predation rates and attributed most predation to mountain lions. These and other authors have attributed the high ram mortality to rams' use of habitat conducive to predation by lions, poor post-rut body condition, and occlusion of rear vision due to their larger horns (Harrison and Hebert 1988, Schaefer *et al.* 2000, Mooring *et al.* 2004). However, other studies found that lambs (Ross *et al.* 1997) and ewes (Krausman *et al.* 1989) were taken more by mountain lions in proportion to their population. Still other studies found that predation rates reflected the proportion of sex and age classes in the population (Hayes *et al.* 2000), or a particular lion's predation habits (Ross *et al.* 1997). In New Mexico, mountain lion management has been used to protect desert bighorn sheep, which were on the New Mexico State endangered species list (New Mexico Game and Fish, 2010). CPW does not currently use routine mountain lion management to protect desert or rocky mountain bighorn sheep in Colorado (George *et al.*, 2009), but WS-Colorado could be asked to assist with such actions in the future, especially where bighorn sheep populations may drop below a level where herd size has anti-predator strategies (Mooring *et al.* 2004).

1.17.5.8 Predation on Nesting Upland Gamebirds, Waterfowl, and Shorebirds.

WS-Colorado has received few requests from CPW or other agencies in recent years to provide protection for nesting upland gamebirds, waterfowl, or shorebirds from predators, most recently in FY12 to protect threatened piping plovers from coyote predation. APHIS-WS also conducts PDM projects in several other parts of the U.S. to protect nesting birds that are federally listed T&E species, and similar assistance might be requested of the WS-Colorado program in the future. For example, APHIS-WS conducted PDM for Attwater's greater prairie-chickens in Texas (USFWS 1998) where predation by skunks, coyotes, and other species was identified as a limiting factor in their recovery. Avian species that are federally listed in Colorado and that could be impacted by predators include: the least tern (endangered) and the Gunnison's sage-grouse (threatened). Additional support may be given to these species should it be determined by an agency with management authority over such species that predation from predators has limited their viability. PDM projects to protect nesting birds are typically of short duration and limited to just prior to and during the critical nesting periods when the eggs, chicks, and setting birds are most vulnerable. PDM activities for nesting birds are typically focused on a few species of mammalian predators known for depredating nests of eggs and nestlings such as raccoons, skunks, and coyotes.

Greater sage-grouse (*Centrocercus urophasianus*) populations have declined throughout Colorado and the western U.S. over the last several decades due to a variety of environmental factors (Connelly and Braun 1997). Sage-grouse occupying habitats that are highly fragmented or in poor ecological condition may exhibit relatively low nest success, low juvenile recruitment, and poor adult survival that may be related to increased predation (Gregg 1991, Conover and Roberts 2017, Dinkins *et al.* 2016, Peebles *et al.* 2017). Populations of some of the most important prairie grouse predators have increased dramatically over the last 100 years (see analysis related to coyote and red fox in Chapter 3), and even in areas of good habitat, predator populations can be so abundant that habitat alone may not suffice to allow grouse populations to increase (Bergerud 1988). Schroeder and Baydack (2001) suggested that as habitats become more fragmented and populations of prairie grouse become more threatened, it becomes more important to consider PDM as a potential management tool. Because damaged sagebrush habitats may take 15-30 years to recover, a PDM strategy that effectively increases nest success and juvenile survival may be useful in offsetting some of the negative effects of poor habitat. This approach might also allow a more rapid recovery of grouse populations following habitat recovery. For example, after 3 years of monitoring the movement, survival, and reproduction of reintroduced sharp-tailed grouse (*Tympanuchus phasianellus*) in northeastern Nevada, Coates and Delehanty (2001) recommended that future reintroductions of sharp-tailed grouse be preceded by 2 months of PDM to increase survival of released birds. In a survey of U.S. public attitudes regarding predators and their management to enhance avian recruitment, Messmer *et al.* (1999) found that, given information suggesting predators are among the threats to a declining bird population, the public generally supported using PDM for the protection of bird populations.

Batterson and Morse (1948) documented heavy predation on sage-grouse nests in northeastern Oregon, and, whereas the greatest limiting factor was common raven (*Corvus corax*) predation, coyotes and badgers also contributed to nest predation. Ravens have been documented to be the most common predator of sage-grouse nests (Coates *et al.* 2008, Lockyer *et al.* 2013). Raven removal has been shown to increase sage-grouse numbers (Peebles *et al.* 2017) and increase nesting success (Dinkins *et al.* 2016). Predation by common ravens could be one of the greatest limiting factors for Gunnison sage-grouse.

Keister and Willis (1986) suggested that the major factor in determining sage-grouse population levels in their study area in southeastern Oregon was loss of nests and chicks during the first 3 weeks after hatching. Coyotes and ravens were suspected as the primary nest predators. A coyote removal project was implemented on their study area, and sage-grouse productivity increased dramatically from 0.13 chicks/hen to 2.45 chicks/hen in just 3 years. Willis *et al.* (1993) analyzed data on sage-grouse and predator populations, weather, and habitat from an area of Oregon that had some of the best sage-grouse habitat in the state. The only meaningful relationship they found was a significant negative correlation between coyote abundance and the number of sage-grouse chicks produced per hen. They concluded that fluctuation in predator abundance was probably the single most important factor affecting annual productivity of sage-grouse in their study area. Presnall and Wood (1953) documented an example illustrating the potential of coyotes as predators on sage-grouse. In tracking a coyote approximately 5 miles to its den in northern Colorado, they found evidence along the way that the coyote had killed three adult sage-grouse and destroyed a sage-grouse nest. Examination of the stomach contents from an adult female coyote removed the next day revealed parts of an adult sage-grouse hen plus six whole newly-hatched sage-grouse chicks. The area around the den was littered with sage-grouse bones and feathers. No other prey remains were found around the den, and it appeared that the pups had been raised largely upon sage-grouse.

Burkepile *et al.* (2001) radio-marked 31 chicks from 13 broods in 1999, and 44 chicks from 15 broods in 2000. Survival estimates for 1999 and 2000 were only 15% and 18%, respectively. Radio-tracking allowed the authors to positively identify the reason for most losses, and they found that predators were responsible for 90% of the mortality in 1999 and 100% of the mortality in 2000. Red fox were believed to be one of the primary chick predators, but predation was also confirmed by unidentified avian and other mammalian predators as well. Bunnell and Flinders (1999) also documented significant predation by red fox on sage-grouse in their study area in Utah, and recently revised sage-grouse management guidelines, suggesting that red fox populations should be discouraged in sage-grouse habitats (Connelly *et al.* 2000). To the extent that red fox, coyotes, and other predators which prey on chicks are also preying on eggs, reducing the populations of these predators from sage-grouse nesting and early brood-rearing areas has the potential to benefit both nesting success and chick survival.

A more recent review of the effects of raven and coyote removal in relation to temporal variation in climate on greater sage-grouse nest success was undertaken (Dinkins *et al.* 2016). Depredation of sage-grouse nests can limit productivity. Ravens have become more abundant in sage habitat due to increases in anthropogenic structures and supplemental food sources. Dinkins *et al.* (2016) showed removal of ravens can increase nest success and may have a place in sage-grouse management as an interim mitigation measure until long term solutions are found. While coyote removal was found less effective in wet years since nest success declined. A number of potential causes for lower sage-grouse nest success during wet years was postulated but the cause of lower nest success was outside the scope of the study. WS-CO conducts intensive coyote removal from Axial Basin in Moffat County to protect sheep on lambing grounds. The Basin is thought to have some of the highest densities of greater sage-grouse in Colorado, likely due to removal of large numbers of coyotes that would depredate adult grouse, chicks and eggs. Coyote removal may benefit sage-grouse.

Habitat losses remains the greatest cause of greater sage-grouse population declines (Connelly at al. 2000, Walker *et al.* 2016) and it has long been recognized that protecting large continuous blocks of viable sagebrush habitat are required for conservation of sage-grouse (Beck and Mitchell 2000). Large expanses of sagebrush were burned or chemically treated after World War 2 for forage production for livestock. Influences of livestock grazing on sagebrush habitats were evaluated by Beck and Mitchell (2000). Livestock impacts on sage-grouse can be positive, negative or neutral (Guthrey 1996). Impacts of livestock grazing on sagebrush is highly variable and related to stocking densities and forage management practices (*e.g.*, fire, herbicides)(Guthrey 1996). Whereas higher densities of livestock in past decades affected sagebrush habitats, (Gunnison Sage-grouse Rangewide Steering Committee 2005), the lower densities of sheep on the range over the last 40 years has likely had less harmful effects. Grazing can reduce fire frequency by reducing fuel loads and can increase sage brush density through grazing. However, trampling by livestock can kill smaller sage brush plants, and over time can affect the plant community. Also, cattle may step on grouse nests. The time of year grazing occurs affects sage brush communities with spring grazing resulting in more sagebrush while fall grazing results in more grasses and forbs. Sage-grouse use sagebrush, grasses and forbs at different times of the year for foraging, raising young and wintering. Livestock grazing can be compatible with sage-grouse when stocking rates are low or moderate since grasses, forbs and sagebrush remain for nesting (Beck and Mitchell 2000). Some higher stocking rates of livestock following a drought can reduce available habitat for nesting sage-grouse. In summary, livestock grazing affects are highly variable with the effects most minimized by stocking rates.

Gunnison sage-grouse (*Centrocercus minimus*) are listed as federal threatened species in Colorado. Gunnison sage-grouse occur on sage brush habitats and rangelands with a sage brush component in central Colorado in and near the Gunnison Basin. The species has declined in abundance due to substantial changes in habitat from human disturbance and small population size (Gunnison Sage-grouse Rangewide Steering Committee 2005). These population declines are exacerbated by the interaction of predation with habitat loss and small population size (Gunnison Sage-grouse Rangewide Steering Committee 2005). Changes in habitat affect the distribution of Gunnison sage-grouse on the landscape. Some habitat changes have resulted in increases in wildlife species that depredate Gunnison sage-grouse resulting in negative population effects.

The decline of Gunnison sage-grouse is due to poor or no productivity (Davis *et al.* 2015), especially among the 7 small satellite populations (Davis *et al.* 2015, Oyler-McCance *et al.* 2005). Taylor *et al.* (2012) found female survival and chick survival were the most important vital rates for greater sage-grouse population growth, which is similar to little to no population growth afflicting Gunnison sage-grouse populations. The poor productivity and survival of chicks is likely attributed to declining habitat quality and introduction of anthropogenic habitat alterations harmful to sage-grouse survival. Many studies report habitat characteristics that have changed to the detriment of Gunnison and greater sage-grouse (Hovick *et al.* 2014, Aldridge *et al.* 2012, Hess and Beck 2012). Whereas habitat loss or change may be the proximate cause of sage-grouse decline, these changes introduce ultimate factors, such as predation, that cause population loss (Gregg and Crawford 2007).

Raven and corvid populations have increased significantly over the last 40 years as man has introduced anthropogenic structures into sagebrush habitat (Coates *et al.* 2016, Coates and Delehanty 2010, Manzer and Hannon 2005). Ravens are one of the predators depredating sage-grouse and in some locations are impacting population growth and survivability of nests and eggs (Coates and Delehanty 2010,). These population losses normally would not occur in pristine sage brush habitat. WS-Colorado has conducted limited raven damage management to protect Gunnison sage-grouse at one satellite population. Management of predation on Gunnison sage-grouse would be determined by CPW and/or USFWS. Management of predation on greater sage-grouse would be determined by CPW and land management agencies. WS-Colorado has no authority to determine whether PDM will be conducted to protect sage-grouse or other natural resources.

Dumke and Pils (1973) reported that ring-necked pheasant (*Phasianus colchicus*) hens were especially prone to predation during their nest incubation period. Trautman *et al.* (1974) examined the effects of predator removal on pheasant populations in South Dakota by monitoring pheasant populations in similar 100 mi^2 plots with and without PDM. They examined two variations of predator removal, one targeting only red fox for 5 years, and the other targeting badger, raccoon, striped skunks and red fox for 5 years. They found pheasant densities were 19% and 132% higher in predator removal areas than in non-removal areas during fox removal and multiple predator species removal, respectively. Chesness *et al.* (1968) examined the effects of predator removal on pheasant populations in paired treatment and non-treatment areas in Minnesota over 3 years by targeting primarily nest predators, including skunks, raccoons, and crows. They reported a 36% hatching success in predator removal areas versus a 16% hatching success in non-removal areas, as well as higher clutch sizes and chick production in predator removal areas.

Thomas (1989) and Speake (1985) reported that predators were responsible for more than 40% of nest failures of wild turkeys (*Meleagris gallopavo*) in New Hampshire and Alabama. Everett *et al.* (1980) reported that predators destroyed 7 of 8 nests on his study area in northern Alabama. Lewis (1973) and Speake *et al.* (1985) reported that predation was the leading cause of mortality in turkey poults, and Kurzejeski *et al.* (1987) reported in a radio-telemetry study that predation was the leading cause of mortality in hens. Wakeling (1991) reported that the leading natural cause of mortality among older turkeys was coyote predation, with the highest mortality rate for adult females occurring in winter. Other researchers report that hen predation is also high in spring when hens are nesting and caring for poults (Speake *et al.* 1985, Kurzejeski *et al.* 1987, Wakeling 1991). Williams *et al.* (1980) reported a 59% hatching success for turkeys prior to a predator poisoning campaign, versus a 72% hatching success following the predator poisoning campaign.

In a study of waterfowl nesting success in Canada, researchers found that eggs in most nests were lost to predators such as red foxes, coyotes, striped skunks, raccoons, Franklin's ground squirrels (*Spermophilus. franklinii*), badgers, black-billed magpies (*Pica pica*) and American crows (*Corvus brachyrhynchos*) (Johnson *et al.* 1988). Cowardin *et al.* (1985) determined that predation was by far the most important cause of nest failure in mallards (*Anas platyrhynchos*) in their study area. Various studies have shown skunks and raccoons to be a major waterfowl nest predators resulting in poor nesting success (Keith 1961, Urban 1970, Bandy 1965). For example, on the Sterling Wildlife Management area in southern Idaho, striped skunks, red fox, and black-billed magpies were documented as common predators of nesting ducks, with magpie predation identified as the most significant factor limiting waterfowl production (Gazda and Connelly 1993).

In documenting the effects of red fox predation on waterfowl in North Dakota, Sargeant *et al.* (1984) concluded that reducing high levels of predation was necessary to increase waterfowl production. Balser *et al.* (1968) determined that PDM resulted in 60% greater production in waterfowl in areas with PDM, as compared to areas without it. They also recommended that when conducting PDM, the entire complex of potential predators should be targeted, or compensatory predation may occur by a species not being managed, a phenomena also observed by Greenwood (1986). Rohwer *et al.* (1997) documented a 52% nesting success for upland nesting ducks in an area receiving PDM, versus only a 6% nesting success in a similar non-treatment area. Garrettson and Rohwer (2001) likewise documented dramatically higher duck nesting success in areas where predators were removed during the nesting season as compared to areas where no predators were removed, and noted that the annual nature of predator removal allowed for greater management flexibility than most habitat management efforts.

Production of sandhill cranes at Malheur National Wildlife Refuge in southeastern Oregon was severely limited by predation from coyotes, ravens, raccoons, and mink. PDM for these species on the refuge resulted in increased colt survival (from 1 crane colt surviving to 60) as well as increased production of other waterfowl (USFWS 1989, 1990, 1991, 1994). Several other predators can also damage nesting waterfowl, primarily their eggs, such as skunks and foxes. Typically the goal of PDM is to suppress local predator populations during the birds' nesting season to increase the birds' production.

1.17.5.9 Other Species.

WS-Colorado may be requested to use PDM to help protect other species as well. If a management agency finds that a particular species has been impacted by predation, WS-Colorado could assist in determining if PDM efforts could help protect the species, and implement any appropriate PDM actions to address it. Species being given protection often are T&E species. For example, one such T&E species that was reintroduced in Colorado and was given protection from predators, especially prior to their reintroduction, is the black-footed ferret. In the first reintroduction effort by USFWS, 34 of 39 reintroduced ferrets were killed by predators. As a result of the impact of predation, PDM is now commonly conducted where ferrets are going to be reintroduced. Several other Federal and State listed T&E species in Colorado are impacted by predators, including Canada lynx and kit fox.

1.17.5.10 Beneficial impacts to native wildlife from livestock protection programs.

Some people want to know about collateral benefits to wildlife populations from WS-Colorado conducting livestock protection programs. These benefits are difficult to measure because CPW measures populations by regions, data analysis units (DAUs), or statewide, depending on the species. Often, livestock protection programs are local in scale, but may cover thousands of acres. Local deer, elk, sage-grouse (Harrington and Conover 2007, Petersen *et al.* 2016) and other wildlife populations may benefit from livestock protection programs. However, like all predator management projects, the benefits need to be related to the biological carrying capacity or stocking rate of the habitat (Monteith *et al.* 2014, Forrester and Wittmer 2013, Hurley *et al.* 2011). If the wild ungulate population is below biological carrying capacity due to predation, then PDM for livestock protection might result in a collateral benefit to the deer or elk population. Conversely, if the deer or elk population is at or near biological carrying capacity, then compensatory mortality from other causes will offset any decrease in predation, and there will be no collateral benefit to the deer or elk population. It would be complex and costly to attempt to quantify these benefits, with no guarantee of meaningful or useful information.

1.18 What is the Effectiveness of the National APHIS-WS Program?

1.18.1 What are Considerations for Evaluating Program Effectiveness?

The purpose behind integrated WDM is to implement methods in the most effective manner while minimizing the potentially harmful effects on people, target and non-target species, and the environment. Defining the effectiveness of any damage management activity or set of activities often occurs in terms of losses or risks potentially reduced or prevented. Inherently, it is difficult to forecast damage that may have been prevented, since the damage has not occurred and therefore must be forecasted.

Effectiveness is based on many factors, with the focus on meeting the desired WDM objectives. These factors can include the types of methods used and the skill of the person using them, with careful implementation of legal restrictions and best implementation practices. Environmental conditions such as weather, terrain, vegetation, and presence of humans, pets, and non-target animals can also be important considerations.

To maximize effectiveness, field personnel must be able to consistently apply the APHIS-WS Decision Model (Section 2.6.2) to assess the damage problem, determine the most advantageous methods or actions, and implement the strategic management actions expeditiously, conscientiously, ethically, and humanely to address the problem and minimize harm to non-target animals, people, property, and the environment. Wildlife management professionals recognize that the most effective approach to resolving any wildlife damage problem is to use an adaptive integrated approach, which may call for the strategic use of several management methods simultaneously or sequentially (Courchamp *et al.* 2003).

APHIS-WS and professional wildlife managers acknowledge that the damage problem may return after a period of time regardless of the lethal and/or non-lethal strategies applied if the attractant conditions continue to exist at the location where damage occurred, predator densities and/or the availability of transient/juvenile animals are sufficient to reoccupy available habitats, and/or if predators cannot be fully restricted from accessing the problem area due to conditions and size of the damage site. However, effectiveness is determined by the ability to reduce the risk of damage or threats caused by predators at the time and, if possible, in the future.

The ability of an animal population to sustain a certain level of removal and to eventually return to pre-management levels eventually does not mean management strategies were not effective for addressing the particular event, but that periodic lethal and/or non-lethal management actions taken during a critical time of the year in specific places may be necessary in specific circumstances. The rapid return of local populations to pre-management levels also demonstrates that limited, localized actions taken to resolve a particular damage problem have minimal impacts on the target species' population (Section 3.1; also see Sections 3.2, and 3.3.1.2).

The use of non-lethal methods described in Appendix A, such as harassment or fright methods, typically requires repeated application to discourage those animals from returning, which increases costs, moves animals to other areas where they could also cause damage, and is typically temporary if habitat conditions that attracted those predators to damage areas remain unchanged. Therefore, both lethal and some non-lethal methods often result in the return of the same or new animals to the area, unless the conditions are changed and/or the animals are physically restrained from the area, such as by fencing.

The common factor when using any WDM method is that new or the original individual predators return if the attractive conditions continue to exist at the location where damage occurred and predator densities and/or the availability of transient/juvenile animals are sufficient to reoccupy all available habitats. One of WS-Colorado objectives is to ensure that all PDM actions cumulatively would not cause adverse effects on statewide target predator populations, or on populations of non-target species (Sections 3.1 and 3.2). Therefore, WS-Colorado policy is not to cause population-wide or even localized long-term adverse impacts to the target species' populations (unless to meet CPW management objectives), or any adverse impacts to populations of native non-target species.

Dispersing and translocating problem predators, particularly animals that have learned to take advantage of resources and habitats associated with humans, could move the problem from one area to another, or the translocated animal could return to its original trapping site. CPW is opposed to the translocation of problem animals, including coyotes and most smaller predators, because of the healthy size of the populations statewide, the high risk of moving the problem along with the animal, and the potential for spreading disease. This avoids causing damage problems at the translocation site, reduces the risk that the animal will return to its original home range, and avoids potentially causing the death of the animal due to occupied territories or unfamiliarity with the new location.

Based on an evaluation of the damage situation using the APHIS-WS Decision Model, the most effective methods should be used individually or in combination based on experience, training, and sound wildlife management principles. The effectiveness of methods are evaluated on a case-by-case basis by the field employee as part of the decision-making process using the APHIS-WS Decision Model for each PDM action and, where appropriate, field personnel follow-up with the cooperator.

1.18.2 How Has the US Government Evaluated the Effectiveness of APHIS-WS PDM Activities

Different values can and do exist among wildlife management agencies, APHIS-WS cooperators, and animal rights and conservation groups regarding wildlife removals, especially lethal removals (for example, Lute and Attari 2016). For meeting various objectives, the government recently conducted two detailed audits of APHIS-WS PDM programs, including the effectiveness of the programs and compliance with federal and state laws and regulations. The audits found that the APHIS-WS PDM programs were both effective and cost-effective.

1.18.2.1 2015 USDA Office of Inspector General Report for Program Effectiveness

In FY 2014, the USDA Office of Inspector General (OIG), conducted a formal audit of the APHIS-WS Wildlife Damage Management program (OIG 2015).

The primary objective of the audit was to determine if WDM activities were justified and effective.

The audit was conducted because the agency had received considerable media attention creating controversy among the general public, animal rights organizations, and conservation groups based on allegations of unsanctioned activities conducted by some of APHIS-WS field personnel. The OIG had received numerous hotline complaints and letters from the general public and animal rights and environmental groups alleging the use of indiscriminant methods capturing non-target species, animals not dying immediately with associated concerns about humaneness (especially being held in traps), and allegations of lack of agency transparency regarding its activities.

For the audit, OIG representatives:

- Observed 40 APHIS-WS field personnel from five states, with audit locations selected based on the high number of takes of selected predators, the most unintentional kills, and/or the most hours on the job with the fewest takes;
- Interviewed 15 property owners/managers and 27 state game and wildlife officials;
- Reviewed Cooperative Service Agreements;
- Sampled logbook entries and reconciled them with the MIS data from January 2012 through January 2014; and
- Reviewed NEPA documentation for predator control.

Auditors observed field personnel setting and checking traps, snares, M-44 devices, and conducting other typical field activities, and interviewed the employees regarding their use of the APHIS-WS Decision Model to assess predation, including auditor confirmation of predator kills of livestock. The auditors watched specifically for indiscriminant killing of non-target animals and suffering of captured animals not immediately killed by the field employees, and found that the field personnel were "generally following prescribed and allowable practices to either avoid or mitigate these conditions."

In cases where non-target animals were captured or animals not killed immediately, the field employee had followed prescribed agency practices, adhering to applicable laws and regulations. Auditors also observed two aerial PDM operations, one for coyotes and one for feral swine, with good coordination between aerial and ground crews and full adherence to applicable laws and regulations. Auditors observed that all producers visited were using some form of non-lethal predator management, such as fencing, guard animals, and human herders, and noted that producers, not APHIS-WS field personnel, most appropriately are responsible for implementing such methods because most available non-lethal methods focus on management of the conditions rather than management of the offending animal.

The audit found that operations involving field personnel and aerial PDM operations "revealed no systemic problems with the process or manner with which the APHIS-WS conducted its predator control program, complying with all applicable federal and state laws and regulations and APHIS-WS' directives associated with WDM activities." The auditors also recognized that "Federal law provides WS broad authority in conducting its program. It also allows WS to take any action the Secretary considers necessary with regards to injurious animal species, in conducting the program."

Based on the interviews, the OIG concluded:

> *"As one property owner put it,* 'WS [field specialists] are an absolute necessity for our business. The number of sheep they save is huge and we cannot function without them…WS specialists are professional and good at what they do.' *In support of this same point, a State game official we interviewed explained that WS provides help for wildlife and is run efficiently. A State agricultural official we interviewed characterized the collaboration of State and Federal programs to manage control of predators and protect domestic livestock and wildlife as* 'seamless'."

OIG had no findings or recommendations to improve the field operational and aerial PDM program actions, and found them both to be justified and effective.

1.18.2.2 2001 Government Accountability Office (GAO) Report to Congressional Committees?

The US Government Accountability Office (GAO) is an independent, nonpartisan agency that works for Congress. Often called the "Congressional watchdog," GAO investigates how the federal government spends taxpayer dollars (GAO 2017). At the request of Congress, the GAO conducted a review of the APHIS-WS' PDM program in 2001 (GAO 2001) to determine:

- The nature and severity of threats posed by wildlife (is there a need for APHIS-WS programs?);
- Actions the program has taken to reduce such threats;
- Studies conducted by APHIS-WS to assess specific costs and benefits of program activities; and
- Opportunities for developing effective non-lethal methods of predator control on farms and ranches.

The GAO met with APHIS-WS personnel at the regional offices, program offices in four states, field research stations in Ohio and Utah, and the National Wildlife Research Center in Colorado. In each state visited, they interviewed program clients, including farmers, ranchers and federal and state wildlife management officials. To obtain information on costs and benefits, they interviewed APHIS-WS economists, APHIS-WS researchers and operations personnel, program clients, and academicians. They also interviewed wildlife advocacy organizations, including the Humane Society of the United States and Defenders of Wildlife, and conducted and an extensive literature survey.

The report summary states:

> *"Although no estimates are available of the total costs of damages attributable to them, some wildlife can pose significant threats to Americans and their property and can cause costly damage and loss. Mammals and birds damage crops, forestry seedlings, and aquaculture*

products each year, at a cost of hundreds of millions of dollars. Livestock is vulnerable as well. In fiscal year 2000, predators (primarily coyotes) killed nearly half a million livestock – mostly lambs and calves – valued at about $70 million. Some predators also prey on big game animals, game birds, and other wildlife, including endangered species…

"Wildlife can attack and injure people, sometimes fatally, and can harbor diseases, such as rabies and West Nile virus, that threaten human health…We identified no independent assessments of the cost and benefits associated with Wildlife Services' program. The only available studies were conducted by the program or with the involvement of program staff. However, these studies were peer reviewed prior to publication in professional journals. The most comprehensive study, published in 1994, concluded that Wildlife Services' current program, which uses all practical methods (both lethal and nonlethal) of control and prevention, was the most cost effective of the program alternatives evaluated. Other studies, focused on specific program activities, have shown that program benefits exceed costs by ratios ranging from 3:1 to 27:1 [depending on the types of costs considered].

"Nevertheless, there are a number of difficulties inherent in analyses that attempt to assess relative costs and benefits. Of most significance, estimates of the economic benefits (savings) associated with program activities are based largely on predictions of the damage that would have occurred had the program's control methods been absent. Such predictions are difficult to make with certainty and can vary considerably depending on the circumstances.

"Wildlife Services scientists are focusing most of their research on developing improved non-lethal control techniques. In fiscal year 2000, about $9 million, or about 75% of the program's total research funding (federal and nonfederal) was directed towards such efforts. However, developing effective, practical, and economical non-lethal control methods has been a challenge, largely for two reasons. First, some methods that appeared to be promising early on proved to be less effective when tested further. Second, animals often adapt to non-lethal measures, such as scare devices (e.g., bursts of sound or light)."

The GAO review found that most non-lethal control methods – such as fencing, guard animals, and animal husbandry practices – are most appropriately implemented by the livestock producers themselves, with technical assistance from APHIS-WS, and most cooperators are already using some non-lethal methods before they request assistance from APHIS-WS (GAO 2001).

1.18.3 Are Field Studies of Effectiveness of Lethal PDM for Livestock Protection Sufficient for Informed Decision-Making?

An analysis of effectiveness of each of the WS-Colorado alternatives considered in detail is found in Chapter 3, including the effectiveness of PDM based on the literature, and how it relates to predator population sustainability (Section 3.1), mesopredator release (Section 3.3) and ecosystem function (Section 3.3).

A recent paper (Treves *et al.* 2016) criticizes research methods used for evaluating the effectiveness of lethal PDM for protection of livestock and recommends suspension of such PDM methods that do not currently have rigorous evidence for functional effectiveness until studies are conducted using what the authors call a "gold standard" study protocol. The "gold standard" protocol recommended by the authors is called the Before/After-Control/Impact (BACI) protocol, which uses a sampling framework to attempt to assess status and trends of physical and biological responses to major human-caused perturbations in the environment. It involves sampling in the area proposed for perturbation before the perturbation occurs and after the perturbation occurs, and comparing the results to each other and to those measured in a control area. This protocol is often used in controlled biomedical research and point-source pollution or localized restoration studies, where the human-caused perturbation is relatively localized and non-mobile.

In order to meet the "gold standard" requested by Treves *et al.* 2016, BACI is best applied using multiple control sites that are sufficiently similar to the perturbed site (Underwood 1992) in order to overcome inherent natural variability in ecological systems, a very difficult standard. Unreplicated sampling involved in the BACI model inherently does not provide the strong inferences that Treves *et al.* (2016) requests for their "gold standard" (Underwood 1992).

In the case of predation management on livestock, finding multiple field study sites that not only prohibit predator management while also allowing livestock grazing is difficult. As experienced in Marin County, California, in the absence of professional predator removal, livestock producers often hire a commercial company or remove animals themselves, often using methods that are not selective for the offending animal (Shwiff *et al.* 2005, Larson 2006).

Depredation on livestock involves highly mobile animals capable of learning and behavior adaption, with seasonal and social biological variations, tested against highly variable livestock management practices and inherently highly variable conditions such as weather, unrelated human activities (such as hunting or recreation), and natural fluctuations in habitat and prey quality and abundance.

APHIS-WS understands and appreciates interest in ensuring PDM methods are as robust and effective as possible. The APHIS-WS NWRC collaborates with experts from around the world to conduct these studies and findings are published in peer-reviewed literature. APHIS-WS supports the use of and uses rigorous, scientifically sound study protocols. APHIS-WS also realizes that field studies involve many variables that cannot be controlled and assumptions that must be acknowledged when trying to analyze complex ecological questions. Wildlife research is inherently challenging because scientists are not working in a "closed" system, such as a laboratory. Researchers must apply study protocols that are capable of differentiating between natural inherent fluctuations and statistically meaningful differences.

Two alternative field designs that are commonly used in wildlife research include a switch-back model and paired-block approach. In the case of a study of the effectiveness of predator management methods on addressing livestock depredation, a switch-back study design involves at least two study areas, one (or more) with predator removal and one (or more) without predator removal. After at least two years of data collection, the sites are switched so that the one with predator removal becomes the one without predator removal, and vice versa, with an additional two years of data collection. The paired-block design involves finding multiple sites that are similar that can be paired and compared. For each pair, predators are removed from one site and not from the other. Using study designs with radio collars on highly-mobile terrestrial predators with interacting social systems also provide a robust method for determining the actual movements, locations, periodicity and seasonality, activity type, social interactions, habitat use, scavenging behavior, and other important factors associated with individual animals, allowing statistical analysis for some study questions and providing the capability for clearer conclusions.

A detailed analysis conducted by APHIS-WS NWRC scientists finds that Treves *et al.* (2016) has misinterpreted and improperly assessed the quality and conclusions of many of the peer-reviewed articles included in their analysis, which causes us to question the authors' abilities to professionally critique such papers and make reasonable conclusions and recommendations. The details of the evaluation of Treves *et al.* (2016) analyses and conclusions are found in Appendix E. This evaluation found that the authors:

- Selectively disregarded studies conducted in Australia, which are some of the more rigorous field studies on working livestock operations with free-ranging, native carnivores that assess the effectiveness of lethal control of predators to protect livestock. Given their explicit criterion to only use studies in their native languages, it is odd that they would purposefully exclude this body of rigorous science published in English;

- Incorrectly confused and combined unrelated papers, reaching unsupportable conclusions;
- Misrepresent the conditions and protocol quality associated with a study testing the effectiveness of fladry;
- Misinterpret study design and criteria used for selection of paired pastures, and incorrectly understand the roles of dependent and independent variables;
- Make false equivalency regarding the use of government-conducted lethal PDM that focuses on removing the individual predators or small groups of predators identified as causing the depredation problem, and regulated public hunting, which is not intended to address predator-caused damage; and
- Use conclusions from studies that they identify as "flawed" for reaching their conclusions.

Underwood (1992) states: "BACI design, however well intentioned, is not sufficient to demonstrate the existence of an impact that might unambiguously be associated with some human activity thought to cause it…[because] there is no logical or rational reason why any apparently detected impact should be attributed to the human disturbance of the apparently impacted location…Thus, such unreplicated sampling can always result in differences of opinion about what the results mean, leaving, as usual, the entire assessment to those random processes known as the legal system."

Therefore, APHIS-WS has determined that it is fully appropriate to continue using existing tools and methodologies, and to continue developing and testing new tools and methods to meet the need for PDM per its statutory mission.

1.19 What Role Does Cost-Effectiveness Play in WDM and NEPA?

A common concern expressed by commenters about government-supported PDM is whether the value of livestock or game population losses are less than the cost of using at least some public funds to provide PDM services. However, this concern indicates a misconception of the purpose of PDM, which is not to wait until the value of losses is high, but to prevent, minimize, or stop losses and damage where it is being experienced, the property owner's level of tolerance has been reached, and assistance is requested. PDM would reach its maximum success if it prevented all losses or damage, which would mean the value of losses or damage due to predators would be zero. However, in the real world, it is not reasonable to expect zero loss or damage. Also, WDM involves not only the direct costs (costs of actual lethal and non-lethal management) but also the considerations of effectiveness, minimization of risk to people, property, and the environment, and social considerations (Shwiff and Bodenchuk 2004).

Evaluating the economic value of losses that would be avoided or minimized with implementation of a PDM program is inherently difficult and very complex (Shwiff and Bodenchuk 2004). Relevant scientific literature suggests that, in the absence of predation management, predation rates on livestock would likely increase (Bodenchuk *et al.* 2002).

Methodologies that attempt to evaluate the economic values of livestock losses and reducing those losses can depend on many variables, such as local market values for livestock, age, class and type of livestock preyed upon; management practices used; geographic and demographic differences; and applicable laws and regulations. However, attempting to evaluate the economic value of success of conservation projects, such as improving the number of surviving elk calves per 100 cows in an areas experiencing high predation in the spring, or the economic value of the predator itself is even more difficult, because wildlife populations have no inherent measurable monetary value, and any such value must therefore be evaluated indirectly, such as through willingness to pay for consumptive or non-consumptive recreation, for example

(Section 1.18). Section 1.18 discusses other factors, complexities, and methods involved in evaluating the economic values of PDM.

1.19.1 Does APHIS-WS Authorizing Legislation Require an Economic Analysis?

No. The Act of 1931, as amended does not incorporate consideration of economic valuations and cost-effectiveness for the WDM program as part of decision-making. In addition to authorizing WDM services, it provides authority for entering into agreements for collecting funds from cooperators for the services the agency provides.

1.19.2 Does NEPA and the CEQ Require an Economic Analysis for Informed Decision-making?

Section 102(2)(B) of NEPA requires agencies to:

"[I]dentify and develop methods and procedures...which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations…"

NEPA ensures that federal agencies appropriately integrate values and effects that are difficult and sometimes impossible to quantify from an effects or cost-effectiveness standpoint into decision-making. Such unquantifiable values can include, for example, the value of viewing wildlife, human health and safety, aesthetics, and recreation.

The CEQ regulations at 40 CFR §1502.23 takes a similar position in support of the law:

"If a cost-benefit analysis relevant to the choice among environmentally different alternatives is being considered for the proposed action, it shall be incorporated by reference or appended to the statement as an aid in evaluating the environmental consequences. To assess the adequacy of compliance with section 102(2)(B) of the Act the statement shall, when a cost-benefit analysis is prepared, discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values, and amenities. For purposes of complying with the Act, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations. In any event, an environmental impact statement should at least indicate those considerations, including factors not related to environmental quality, which are likely to be relevant and important to a decision."

WS-Colorado has determined that there are important qualitative values that are relevant and important to its decision-making that are considered in this EA, but that those considerations will not be monetized. Estimates of non-monetary cost and benefit values for public projects that are not priced in private markets can be difficult to obtain, and methodologies can only produce implied monetary values that are subjective and require value judgments. Selecting an appropriate discount rate to measure the present monetary value of costs and benefits that will occur in the future is also difficult and subjective, with the level of the discount rate creating dramatically different project benefits.

Cost-effectiveness is not the primary goal of APHIS-WS. Additional constraints, such as environmental protection, land management goals, presence of people and pets, and social factors are considered by the field employee using the APHIS-WS Decision Model whenever a request for assistance is received. These constraints may increase the cost of implementing PDM actions while not necessarily increasing its effectiveness, yet they are a vital part of the APHIS-WS program (Connolly 1981, Shwiff and Bodenchuk 2004). Connolly (1981) examined the issue of cost-effectiveness of federal PDM and concluded that public policy decisions have been made to steer the program away from being as cost-effective as possible, including the restriction of management methods believed to be highly effective but less environmentally or socially preferable, such as toxic baits, including traps and the Livestock Protection Collar, which is highly specific to the offending animal (Shelton 2004). Also, state and local jurisdictions are limiting the methods available for PDM. Thus, the increased costs of implementing the remaining more environmentally and socially acceptable methods to achieve other public benefits besides resource and asset protection could be viewed as mitigation for the loss of effectiveness in reducing damage.

Services that ecosystems provide to resources of value to humans can be considered in qualitative and/or economic terms. The Memorandum entitled "Incorporating Ecosystem Services into Federal Decision Making" issued by the CEQ, the Office of Management and Budget (OMB) and the Office of Science and Technology Policy on October 7, 2015 (OMB *et al.* 2015) does not require an economic test for the ecological services to be considered valuable.

The Memorandum states:

> *"[This memorandum] directs agencies to develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments, and regulatory contexts. (Consideration of ecosystem services may be accomplished through a range of qualitative and quantitative methods to identify and characterize ecosystem services, affected communities' needs for those services, metrics for changes to those services, and, where appropriate, monetary or nonmonetary values for those services.)…Adoption of an ecosystem-services approach is one way to organize potential effects of an action within a framework that explicitly recognizes the interconnectedness of environmental, social, and, in some cases, economic considerations, and fosters consideration of both quantified and unquantified information."*

Therefore, neither NEPA nor CEQ guidance requires economic analyses for informed decision-making unless relevant to the understanding differences among alternatives.

The qualitative considerations at issue in this EA are evaluated in Chapter 3 and the agency's decision based on all considerations, including non-quantifiable values, will be explained in the decision document.

1.19.2.1 Are the Recommendations of Loomis (2012) for Economic Analysis Applicable to APHIS-WS Activities?

A non-peer reviewed Issue Paper prepared by Loomis (2012) for the Natural Resources Defense Council "strongly recommended" that APHIS-WS improve its economic analysis methods for its PDM programs. APHIS-WS disagrees with the author's conclusion and recommendations.

Loomis (2012) argues that APHIS-WS should apply the same economic approach required by Congress for large capital improvement projects using natural resources (such as water) by:

"…honestly evaluating which programs are legitimately a high priority for funding [which] may aid Wildlife Services in dealing with USDA and US Office of Management and Budget…While economics should not be the only factor considered in natural resources management, economics is frequently an issue raised by one side or the other in these contentious debates over predator management. Having accurate and objective economic analysis can aid Wildlife Services in judging the validity of these claims."

Loomis (2012) questions the actual need for livestock protection from predators in support of agricultural profitability, and strongly recommends that economic analyses be conducted by APHIS-WS. His argument is based on policies of several federal agencies with substantially different missions and projects for preparing economic analyses as the basis for "*strongly recommend[ing]*" that APHIS-WS do the same.

The agencies the author uses as examples are those that either fund or construct major civil works actions (capital improvement projects) with long life spans, such as the US Army Corps of Engineers (USACE), the Federal Highway Administration (FHWA), the Bureau of Reclamation (BOR), Tennessee Valley Authority, and the Federal Emergency Management Agency. Loomis (2012) especially uses the National Economic Development requirements for large water projects funded and/or constructed by BOR and USACE as the example for APHIS-WS use. However, Congress has specifically required that the BOR and USACE consider the National Economic Development (NED) for decision-making for their large civil works water projects (such as large dams, river management, etc.) which "*necessarily confronts choices among possible alternative courses of actions that involve tradeoffs in economic and other opportunities*" (USACE 2009). The NED is required because, as the report quotes from the USACE Principals and Guidelines "*Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units….*" Regarding the selection of a particular plan for a particular water-related civil works project, *"A plan recommending Federal action is to be the alternative plan with the greatest net economic benefit consistent with the Nation's environment (the NED plan)… [which must be selected] "unless the Secretary of a department or head of an independent agency grants an exception when there is some overriding reasons for selecting another plan, based on other Federal, State, local and international concerns.*" This requirement assumes that "*federal civil works investments should be considered only for project plans that maximize net economic benefits – measured in terms of a single index of monetary value – realized by the nation as a whole*." Decision-making for USACE and BOR large water-related civil works projects is driven primarily by economic and public benefits considerations at the national level, with other factors given secondary consideration.

The Natural Resource Conservation Service (NRCS), another example used by Loomis (2012), is required by Congress to conduct economic analyses for agency decision-making regarding whether to fund conservation projects, especially under Congressional statutes such as Farm Bills (NRCS 2017). FHWA considers costs of various alternative ways of meeting highway transportation needs, but is not required to rely on the results of economic analyses for its decision-making.

It is clear that these examples of agency uses of economic analyses, most of which are Congressional statutory requirements for large civil works projects or other large Federally-funded projects, are not directly relevant to a "fee for service" agency such as APHIS-WS in which Congress has not required any economic test for its WDM services, and which is supported by both Congressional appropriations and cooperator contributions and funds. The need for large capital improvement projects that use or impact large quantities of natural resources are typically already approved and funded by Congress through legislation; the agency decisions remaining are specifically how to meet the approved need through the consideration of the cost-effectiveness of alternative means, as mandated by Congress through consideration of the NED at the national level. These analytic economic models and considerations required by Congress to be used for decision-making by federal agencies regarding large civil works/capital improvement) projects are not applicable for APHIS-WS decision-making at the national, regional, or local levels.

1.19.3 How Have Recent Studies Considered Economic Evaluation of WDM Activities?

Recognizing that many factors affect the viability and profitability of livestock operations, predation on livestock is clearly one. Livestock losses are also not experienced uniformly on all properties across the industry; a few producers often absorb the majority of losses, especially those on public rangelands and private properties adjacent to protected habitats (Shelton 2004).

A study in Wyoming of ranch-level economic impacts in a range cattle grazing system conducted by economics professors at the University of Wyoming (Rashford *et al.* 2010), indicates that predation on calves can have a substantial impact on ranch profitability and long-term viability through loss of calves available for sale, increased variable costs (such as hay and feeds, veterinary costs, fuel, equipment repair, trucking, and labor) per calf, and, anecdotally perhaps, weaning rates from predator harassment. The study found that increased calf loss "takes a larger toll on profits because it erodes the ranch's core profit center, calf sales…The results suggest that predation can have significant impacts on both short-term profitability and long-term viability depending on the mechanism [by which predation can affect profits]." The study identifies social and ecosystem benefits to keeping ranches in the western US viable and profitable through the open spaces and wildlife habitat they provide. The study concludes that "predator control activities would only need to reduce death loss due to predators or reduce predator impacts on weaning rates by approximately 1% to be to be economically efficient…The relationship between predation, ranch viability, and the ecosystem services provided may justify public spending on predator control." Further research is needed on whether these factors cumulatively impact ranch profitability.

The audit conducted by the GAO (2001) concluded, based on studies focused on specific APHIS-WS PDM activities in different areas of the country, they evaluated, that livestock PDM activities are economical, with benefit to cost ratios ranging from 3:1 (comparing the market value of all livestock saved in 1998 with the cost of all livestock protection programs in place) to 27:1 (comparing total savings with federal program expenditures, including a measure that shows the potential ripple effects on rural economies). PDM to protect wildlife shows a benefit to cost ratio of 2:1 to 27:1. Activities performed to protect human health and safety are impossible to quantify, but the value of a human life is incalculable. The GAO (2001), however, recognized that estimates of the economic benefits (savings) associated with program activities are based largely on predictions of the damage that would have occurred had the program's control methods been absent, with inherent uncertainties, substantial variations in circumstances, and inability to distinguish between the results of PDM activities and other factors such as weather, disease, and natural fluctuations in predator and prey populations.

Most economic analyses of the relationship of livestock profitability and predator control are conducted at the scope of contribution to local and regional economies. This approach dilutes the recognition that some ranch operations are impacted financially by predation at a higher rate than others, depending on factors such as livestock being grazed adjacent to quality predator habitat (such as ranches near federal lands resulting in "predator drift;" Shelton 2004), grazing overlapping with predator territories, and grazing in areas with high concentrations of unprotected livestock, especially during lambing and calving. Based solely on need expressed by livestock operators on public and private lands, APHIS-WS does not operate on every ranch operation, only those experiencing predation problems, and then only those requesting assistance from APHIS-WS. APHIS-WS operates PDM with paying cooperators at the individual ranch operation level, not the regional level, which is not reflected in typical economic analyses published in the literature (Rashford *et al.* 2010, Loomis 2012, for example). This approach also does not consider support for other needs for which APHIS-WS is routinely requested, such as threats to human/pet health and safety, operations at airports, risk of wildlife disease spread, and protection of property.

A team of economic specialists from the NWRC conducted an economic assessment of select benefits and costs of APHIS-WS in California. The assessment focused primarily on damage in agricultural areas because urban wildlife damage figures were not readily available. During the study year, cooperating California counties paid on average 57% of the cost of their WS-California specialists. Results of the study indicate that for every $1.00 California counties invest in APHIS-WS, they save between $6.50 and $10.00 in wildlife damage and replacement program costs (Shwiff *et al.* 2005).

Considering the total cost of APHIS-WS field personnel, the benefits were found to be between $3.71 and $5.70 for every $1.00 of county investment.

Other studies have shown positive results for benefits to costs. Shwiff and Merrell (2004) reported 5.4% increases in numbers of calves brought to market when coyotes were removed by aerial PDM. Wagner and Conover (1999) found that the percentage of lambs lost to coyote predation was reduced from 2.8% to less than 1% on grazing allotments in which coyotes were removed 3-6 months before summer sheep grazing.

Variables that would change the cost to benefit ratio of a damage management program include: local market values for livestock, age, class and type of livestock preyed upon, management practices, geographic and demographic differences, local laws and regulations and APHIS-WS polices, the skill and experience of the individual APHIS-WS employee responding to the damage request, and others.

1.19.4 What are the Various Factors and Methods for Evaluating Cost-Effectiveness?

Bodenchuk *et al.* (2002), Shwiff and Bodenchuk (2004), and Shwiff *et al.* (2005) describe the primary types of considerations for conducting economic analyses of PDM:

- **Direct Benefits:** These are typically calculated as the number of individual animals saved from predation, representing a cost savings, in that with predation management a certain number of losses or amounts of costs can be avoided. The dollar value of the species or animals saved represents the direct benefits of the program and the losses avoided by producers. However, determining the market value for livestock and wildlife species saved is difficult, with livestock usually valued using market price, which is typically conservative, and wildlife species using civil values. Number of animals lost in the absence of PDM activities is difficult to determine. Also reported losses are most likely substantially fewer than actual losses, as many losses are not reported to authorities, not all losses are found in the field, and many carcasses found are too consumed or decayed to make a clear determination of cause of death and species responsible.
- **Spillover Benefits (secondary, indirect, or incidental benefits):** These benefits are an unintentional side effect of the primary purpose of the PDM program, and may be evaluated using multiplier values from the direct benefits. Spillover benefits can include benefits to wildlife populations in the same geographic area. Indirect benefits can include benefits to local and regional economies.
- **Intangible Benefits:** Such benefits include increased cooperation from landowners as a result of the implementation of PDM, such as facilitating landowner participation in other conservation efforts or potentially minimizing amateur efforts to control predators, which may not be as selective or humane as those conducted by trained professionals.
- **Direct Economic Effects/Costs:** These costs reflect the value of losses to the livestock operator and the associated reductions in purchases for directly supporting those livestock as well as the costs of lethal and non-lethal PDM activities for protection of livestock and/or localized wildlife species, such as valued big game species, recently introduced native species, or ESA-listed species,.
- **Indirect Economic Effects:** These effects are generated as livestock loss alters producer purchases of supplies from other industries in the region and outside the region, resulting in additional jobs, increased income for the region, and greater tax revenues.

All of these factors are complicated, interrelated, and difficult to delineate and quantify. As different economic studies use different factors, values, and multipliers, they are very troublesome to make comparisons.

The following summarizes the types of economic analyses typically applied to PDM, especially associated with livestock contributions to regional economies (discussed in Schuhmann and Schwabe 2000, Shwiff *et al.* 2005, Rashford and Grant 2010, Loomis 2012, Shwiff *et al.* 2012):

- **Cost: Benefit Analysis:** Considers measures of costs that include financial costs (out of pocket expenditures such as for fencing and guard dogs) and opportunity costs (benefits that would not be availability to society based on predator control actions taken today) and measures of benefits as evaluated by a consumer's (increase in enjoyment/satisfaction) or producer's (increases in profit) willingness-to-pay (WTP) for one more unit of the identified "good", considered either on a personal level or societal level. On a personal level, the "good" is considered to have economic value if the individual person (recognizing that individuals have differing value systems) receives enjoyment/ satisfaction from the "good" and if the "good" is to some degree scarce. Opportunity costs must also be considered – costs/resources spent on a good that cannot then be used for another purpose. On a societal level, many public natural resources, such as wildlife, may not have a direct market value, but provide satisfaction and enjoyment to some (but not all) segments of society. This is a difficult and subjective analysis (despite its attempt at quantification), as the direct and indirect factors and discount rates included in such an analysis must be carefully considered and evaluated accurately for the contribution they play, or this type of analysis can substantially misrepresent the actual situation and/or be readily disputed. See Section 1.14.2.1 for an explanation of how this approach is used for large capital improvement projects considered on a project-level basis but applied on a regional and national basis as the foundation for determining if and what level the federal government will provide Congressional appropriations. Congress requires this approach for several agencies for such capital improvement projects for setting federal policy in the large-scale public interest.
- **Willingness to Pay:** Studies have identified the WTP for non-market goods such as wildlife recreation (mostly hunting, fishing, and wildlife viewing) for individual species, and, to a substantially lesser degree, ecosystem services, such as clean drinking water, pollination and pest control for agriculture, and renewal of soil fertility. WTP can also be used to monetize existence or passive values, such as the value of knowing that a species exists somewhere in the wild, even if the individual never spends any money to actually experience it in the wild.
- Methods used to determine or using WTP have included:
  - **Recreational Benefits:** Considering the costs of travel to experience enjoyment of non-market recreational experiences (Travel-Cost Method; TCM), using a demand curve above actual travel costs obtained through surveys with recreationists, reflecting actual behavior. Shwiff *et al.* (2012) summarize the primary criticisms of TCM: assumptions that visitors' values equal or exceed their travel costs, because travel costs are not an accurate proxy for of the actual value of the good; values must also be assigned to the time individuals spend traveling to the site, including opportunity costs (time spent traveling cannot be spent doing some other activity) since each person values their time differently; human access to conservation sites may be limited (including access to private land) and individuals may not be aware or have a preference toward the species associated with a chosen recreation site; and if individuals are not willing or able to travel to the site to expend funds, then this method confers no value.
  - **Existence/ Altruistic/Bequest Benefits** (depending on whether the benefit is enjoyed by the individual now or by other individuals now, or by other individuals in the future): Constructing a hypothetical or simulated market and surveying individuals if they would pay an increase in their trip costs or an increase in their taxes/utility bills/

overall prices for increasing environmental quality, including wildlife populations, recognizing that they higher the dollar amount respondents are asked to pay, the lower the probability that they would actually pay (Contingent Valuation Method; CVM). This includes situations in which individuals are willing to provide donations to environmental groups to protect resources that they care about but may never experience themselves. Shwiff *et al.* (2012) summarize the primary criticisms of CVM: the hypothetical nature of the questionnaires, the inability to validate responses, the high costs of conducting this type of survey, and the difficulty of identifying the target audience. Also, public goods such as wildlife to not lend themselves to this type of valuation and this valuation tends to understate the true non-market value.

- **Benefit Transfer to Other Locations:** Extrapolation of WTP results from one area to another, recognizing that the extrapolation may or may not be reasonable or applicable in another area depending on circumstances. Shwiff *et al.* (2012) summarize the primary criticisms of the benefit transfer method: the reliability of this methods may be inconsistent as this method depends on estimates created using the CVM or TCM methods; wildlife values in one area may be unique and simply transferring the value associated with a species in one location to the same species in another location does not capture local qualities; preferences and willingness to pay for those preferences may not account for all the values and benefits of wildlife conservation projects, including ecosystem services.
- **Regional Economic Analysis:** Shwiff *et al.* (2012) describe this method as including estimation of secondary benefits and costs associated with the conservation of wildlife species in units of measure that are important to the general public (revenue, costs, and jobs). Increasing wildlife populations (the primary benefit) may have secondary benefits such as increase consumptive and non-consumptive tourism, which can be estimated using multipliers to account for changes spread through economic sectors. Loomis and Richardson (2001) used WTP estimates obtained from CVM and TCM studies for estimating the value of the wilderness system in the US. This requires the use of computer models, which can translate conservation efforts into regional impacts on revenue and jobs. However, secondary benefits or costs cannot be incorporated into a cost-benefit analysis because losses in one region may become gains in another region, potentially leading to offsetting effects.

As Schuhmann and Schwabe (2000) conclude:

- "*While these methods [CVM and TCM] are widely used, it is important to stress that none of the approaches mentioned is without its flaws. Indeed, there is continual debate on the validity and tractability of each method…*
- *"There is little uncertainty that wildlife-human conflicts impose significant costs on society. Yet, as most wildlife managers, hunters, and nature enthusiasts would agree, there is also enormous value associated with these same wildlife resources.*"

In addition, the Paperwork Reduction Act of 1995 requires agencies to submit requests to collect information from the public to the Office of Management and Budget (OMB) for approval for surveys used for general-purpose statistics or as part of program evaluations or research studies. Therefore, any surveys conducted for the purposes of determining WTP and related questions must have all survey questions and designs approved by the OMB. Developing a high quality survey require professional assistance in designing, executing, and documenting their surveys. This requirements makes it very difficult and expensive to conduct public surveys.

1.19.5 What are the Economic Results of the Marin County CA Predator Damage Replacement Program Compared to the WS-California Program?

1.19.5.1 What is the Marin County Predator Damage Replacement Program?

In 2003, concomitant with severe fiscal issues affecting the State of California's budget, California's Vertebrate Pest Control Research Advisory Committee funded a comprehensive economic assessment of APHIS-WS operations in the state (Shwiff *et al.* 2005, Shwiff *et al.* 2006). At the time, the WS-California program had cooperative service agreements and memoranda of understanding with 40 of the 58 counties. Each cooperating county provides funds for WS-California operations. While most farmers and ranchers have long offered testimony to the savings incurred from WS-California activities related to predator control, analyses to substantiate these claims were lacking. Shwiff *et al.* (2006) summarizes the results of the study for FY 2003 and 2004, including a comparison with the livestock replacement program in Marin County, which did not include lethal predator management.

WS-California District Supervisors responded to a survey, with validation from the APHIS-WS Management Information Service (MIS) database, that the primary reasons for requests for assistance with predator damage protection for sheep, cattle, and goats; health and human safety; natural resources protection (including services to protect riparian areas, trees and timber, and rangeland; and protection of property, such as buildings, landscaping, and irrigation and dams. These services are considered to have economic values that cannot be determined using market valuations. Therefore, a value for the WS-California services that would be replaced (replacement-cost method) is inferred by finding similar market values where the price or quantity change was used to represent the missing market value, with the focus on livestock (sheep and cattle) protection replacement and human health and safety/natural resources/property replacement.

Marin County, California, near San Francisco, created an equivalent program for protection of commercial sheep enterprises, called the Ranch Improvement/Non-Lethal Control and Indemnity Plan, which estimates the costs associated with replacing PDM services and associated costs provided by WS-California with non-lethal methods only. The Plan originally involved: 1) monetary reimbursement to ranchers for their costs associated with creating protective facilities and improvements such as fencing, guard dogs, and scare devices; and 2) indemnification – compensation for livestock lost to predation, using market price/head lost.

Under the current non-lethal Marin County Program, qualified ranchers are provided cost-share funding to assist in the implementation of non-lethal management methods to reduce depredation such as through new fence construction or improvements to existing fences, guard animals, scare devices, or changes in animal husbandry. The most commonly used methods by producers are guard dogs and fencing (Larson 2006). To qualify for the program, ranchers must have at least 25 head of livestock and must use two non-lethal methods to deter predation, as verified by the Marin County Agricultural Commissioner. The Marin County program provides an annual subsidy to enrolled landowners for the purchase or maintenance of nonlethal/exclusionary equipment. It requires no receipts be turned in or reporting of application of methods, resource protection numbers, predation losses, or any other measure of success.

Initially, producers who qualified for the program could also receive compensation for sheep and lambs lost to predation. However, the program was unable to pay the cost of all losses to predation and, in 2003, compensation payments were capped at 5% of the number of adult animals in the herd. However, when the Marin County Department of Agriculture, in a December 2014 California Public Records Request, was asked for records reflecting whether and to what extent the Program addresses or pays for the depredation of, or damage caused by, coyotes, mountain lions, feral swine (wild hogs and boars), free roaming and/or feral dogs, gray fox, striped or spotted skunks, possums, and other common wild animals, Marin County indicated that the Livestock Protection Program was only a cost-share program to provide limited funds for purchasing fencing materials and guard animals.

1.19.5.2 How Do the Costs of the Marin County Program Compare to WS-California Program?

Shwiff *et al.* (2005) evaluated the replacement-cost methods using predation rates of 1.5% for year 1 and 3.2% for year 2, based on the number of lambs lost to predators in each year and a hypothetical lamb crop of 1.5 lambs/ewe. Indemnification costs at these levels of predation were calculated by multiplying the number of lambs lost to predation by the market price given in the livestock protection replacement program ($70/head at year 1 and $82/head in year 2). The total cost of replacing the WS-California services in each cooperating county was evaluated as the cost of monetary reimbursement for protection improvements and indemnification for losses that each county would incur under this replacement program as experienced in Marin County.

To estimate the costs of replacing the WS-California services for capturing and removing animals that pose health or human safety threats or cause damage to natural resources or property, the costs of pest control providers across California were averaged based on telephone surveys, resulting in multiplying the number of incidents documented in the WS-California MIS database by $170.00 for most cases and by $395.00 for coyote incidents, considering a single trap setup and animal capture (costs are not directly comparable because WS-California field personnel would set multiple traps and capture multiple animals for each task). Since private commercial operators in California would not provide costs for removal of large predators such as cougar and bears, the multiplier for these species was developed using the multiplier for coyote, recognizing that the replacement cost was likely higher.

Assuming that WS-California activities prevented or suppressed wildlife-caused damages in cooperating counties, damage to agriculture, health and human safety, natural resources, and property would likely increase in the absence of a federal program. The damage-avoided cost used the value of livestock protected and jobs saved or protected that support the livestock industry in the county as a measure of the benefits provided by WS-California that would be replaced, using an input-output model. The change inputted into the model was the increase in expected predation rates for both sheep and cattle, based on the literature and predation rates in Marin County under the livestock protection replacement program, resulting in increased predation rates for sheep at 2%, 2.5%, and 3% and for cattle at 1%, 1.5%, and 2%. The savings in damage costs avoided in the livestock sector was measured by the amount of revenue and the number of jobs affected by having the WS-California acting in each county. The benefit of human health and safety, natural resources, and property protection was determined by estimating a hypothetical increase in the amount of damage under each category (assuming increases of 25%, 50%, and 100% for projected damage).

The study found that the costs of replacing WS-California activities with private activities for WDM in the cooperating counties was almost $174,000 in year 1 and over $226,000 in year 2, while county share to WS-California for providing those services averaged almost $52,000, showing substantial savings using the federal program. Assuming that damage from wildlife would increase from 25% to 100% without WS-California activities, the counties would have incurred between $5,759,000 and $10,636,000 in additional expenses. The net value of WS-

California operations was calculated to range from approximately $10,394,000 and $17, 257,000.

A review of Marin County's budget over the first five years of the non-lethal program's implementation found that on average the program cost Marin County 1.2 times the amount that the cooperative APHIS-WS PDM program cost the county in its highest year (Larson 2006). These budget evaluations only record the county's cost for implementation, and do not capture the additional landowner costs associated with this program. The inability of the program to pay compensation for all livestock losses and the need to cap loss indemnity payments are also noteworthy.

The WS-California program achieves economy of scales that individual replacement programs cannot, such as the ability to use a broad spectrum of methodologies and resources to address wildlife damage problems. Therefore, it was assumed that rates of predation would be higher and resulting damages greater with only compensation for non-lethal activities and indemnification. Cooperating counties also receive indirect benefits from the WS-California program, such as federal compliance with NEPA and ESA, training and certification of field personnel in firearm and chemical use and disposal, access to research and study results and technical support on diverse pesticide registration and use issues, provided by the APHIS-WS National Wildlife Research Center, and best management practices for capture and handling of problem wildlife.

1.19.6 What are Economic Concerns Commonly Expressed by Public Commenters to APHIS-WS PDM EAs?

Commenters often request economic analyses that incorporate the combination of the economic contributions of resource and agricultural protection programs and the economic contribution of wildlife-related recreation and values of the existence of wildlife, especially predators, on ecosystem services and recreation opportunities. Aspects of these values are included in this EA in the evaluation of impacts to target and non-target populations (Sections 3.1 and 3.2), ecosystem function (Section 3.3), and use of public lands (Section 3.5).

Commenters to APHIS-WS PDM EAs commonly express concerns about the economic costs of PDM in relation to the economic values being protected, especially values related to livestock, and whether the use of public funds are appropriate to support private profits. These are discussed here and several are included in Section 2.10, Alternatives Not Considered in Detail.

1.19.6.1 Use of Taxpayer Funds for Private Profit, Livestock Losses Considered a Tax Write-off, and Livestock Losses Should Be an Accepted Cost of Doing Business?

Some people and groups have commented that they do not want APHIS-WS to use taxpayer funds to benefit private commercial enterprises, such as livestock operations, and that producers should consider their losses to predators as a cost of doing business. Some believe that producers receive sufficient tax write-offs for their predation losses.

The national policy of using taxpayer dollars for subsidizing private or commercial profit, such as for protecting livestock from predators on private or public lands is established by Congress through statutes such as the Federal Land Policy and Management Act, the Multiple Use-Sustained Yield Act requiring multiple use of federal lands, including for livestock grazing, and the APHIS-Wildlife Services authorizing act, and Congressional appropriations. As wildlife belongs to the American public and is managed for many uses and values by tax-supported state and federal agencies, it is national policy that some of the resolution of damage caused by those same species is also publicly supported. Federal and state funds also support research and management of wildlife-related diseases, especially those that can be transmitted to livestock, pets, and humans. Furthermore, APHIS-WS is a cooperatively funded program, and WS-Colorado is also funded by private and commercial entities that request its services.

APHIS-WS is not involved in establishing or approving national policies regarding livestock grazing on federal lands or supporting private livestock operations, but provides federal leadership in resolving wildlife-human conflicts and supporting coexistence of wildlife and humans. It is publicly accountable for the work that is requested by public and private entities and landowners, state and federal governments, tribes, and the public, and all activities are performed according to applicable laws and its mission and policies.

WS-Colorado is aware of beliefs that federal WDM should not be allowed until economic losses become "unacceptable," and that livestock losses should be considered as a cost of doing business by producers. WS-Colorado receives requests for assistance when the operator has reached their tolerance level for damage or worries about safety and health, as well as in circumstances where the threat of damage is foreseeable and preventable. This tolerance level differs among different people and entities, and at different times. Although some losses can be expected and tolerated by agriculture producers and property owners, WS-Colorado is authorized to respond to requests for assistance with WDM problems, and it is agency policy to respond to each requester to resolve losses, threats and damage to some reasonable degree, including providing technical assistance and advice. The APHIS-WS Decision Model (APHIS-WS Directive 2.201) is used in the field to determine an appropriate strategy on a case-by-case basis. The APHIS-WS authorizing legislation does not require an economic analysis at any scale of operation.

Some people believe that livestock producers receive double financial benefits when APHIS-WS provides services to producers because producers have a partially tax-funded program to resolve predation problems while they also receive deductions for livestock lost as a business expense on tax returns. However, this idea is incorrect because the Internal Revenue Service (IRS) does not allow for livestock losses to be deducted if the killed livestock was produced on the ranch and not purchased from an outside source (IRS 2016). In the western United States, a large proportion of predation occurs to young livestock (lambs, kids, and calves), and many adult ewes, nannies, and cows are added as breeding stock replacements to herds from the year's lamb, kid, and calf crop. Any of these animals lost to predation cannot be "written off" since they were not purchased. These factors limit the ability of livestock producers to recover financial losses through tax deductions.

This issue is appropriately addressed through political processes at the state and federal levels.

1.19.6.2 Compensation for Losses or Damage Should Replace APHIS-WS PDM

Wild mammals are typically managed by the state, regardless of land ownership. Some states have established programs to partially accept monetary responsibility for some types of wildlife damage. However, there is currently no system in place to equitably distribute the costs of wildlife damage among all consumptive and non-consumptive user groups. It is under these circumstances where a particular state or county may provide for compensation for wildlife damage (for example, Bruscino and Cleveland 2004).

Colorado's policy regarding compensation for losses of livestock to bear and cougar is set by state law. APHIS-WS and WS-Colorado have no legal authority or jurisdiction to provide financial compensation for losses.

The Agricultural Act of 2014 (aka the 2014 Farm Bill) has provisions for the federal government to provide indemnity payments to eligible producers on farms that have incurred livestock death losses in excess of the normal mortality, as determined by the Secretary of

Agriculture, due to attacks by animals reintroduced into the wild by the Federal Government (such as wolves) or protected by Federal law [such as animals protected under the Migratory Bird Protection Act (MBTA) or the Endangered Species Act (ESA)]. Payments are equal to 75% of the market value of the applicable livestock on the day before the date of death. The Secretary of Agriculture or designee makes that determination. None of the predators considered in this EA are applicable under this statute.

Bulte and Rondeau (2005) also argue that compensating producers for livestock losses may also result in decreased producer efforts to prevent damage, unless the producer is incentivized by making compensation connected to conservation outcomes as well.

This issue is appropriately addressed through political processes at the state and federal levels.

1.19.6.3 Livestock Producers Should Pay All Costs of PDM

The Act of 1931, as amended, authorizes the Secretary of Agriculture to make expenditure of resources for the protection of agricultural resources. Congress makes annual allocations to APHIS-WS for the continuing federal action of WDM, including PDM. Congress further establishes that APHIS-WS may receive and retain funds provided by other entities (*e.g.*, States, industry, public and private funds) and use them towards those programs from which funds were received. In Colorado, this funding is made up of about 31% from Congressional appropriations, 18% from federal and state interagency agreements, and 51% from private or commercial cooperators. Cooperators pay the costs of non-lethal actions taken, even when recommended by WS-Colorado personnel, and a substantial proportion of the cost for WS-Colorado efforts, including WS-Colorado administrative overhead.

This issue is appropriately addressed through political processes at the federal levels.

1.19.6.4 A Program Subsidizing Non-lethal Methods Implemented by Resource Owners Should Replace APHIS-WS PDM

APHIS-WS has no legal authority or jurisdiction to provide for financial subsidies for resource owner implementation of non-lethal methods such as fencing or guard animals. WS-Colorado may rarely loan harassment equipment on very limited circumstances. The State of Colorado also provides no subsidies. Subsidies for use of non-lethal methods to selected types of livestock producers is currently offered in Marin County, California by the County to some degree, but the costs and effectiveness are not clearly known (Shwiff *et al.* 2005, Shwiff *et al.* 2006).

This issue is appropriately addressed through political processes at the state and federal levels.

1.19.6.5 Incorporate the Environmental Costs of Livestock Grazing on Public Lands into Cost Analyses

Commenters have requested that APHIS-WS consider the environmental costs of grazing on public lands and other activities in cost analyses. As stated earlier, APHIS-WS has no authority to address national policy set by multiple Congressional statutes regarding livestock grazing on federal lands, nor annual appropriations related to livestock grazing and other uses on public lands, or private lands, for that matter. APHIS-WS only responds to requests for assistance, and uses the APHIS-WS Decision Model to determine appropriate responses, considering factors that include social and environmental considerations and the specific circumstances and species associated with the damage, in addition to efficacy and costs.

Therefore, this issue is not pertinent to APHIS-WS decision-making, and is appropriately addressed through the political process at the Congressional level.

1.19.6.6 No Federal Funds Should Be Used to Support State PDM Needs for Protection of Game Species

APHIS-WS' policy and objective is to consider and respond appropriately to all requests for PDM assistance. WS-Colorado ultimately decides when it is appropriate to enter into agreements with CPW to assist with meeting state game management objectives.

This issue is appropriately addressed through the political process at the state and Congressional levels.

1.19.6.7 APHIS-WS Should Be Financially Liable for Pet Dogs that Are Incidentally Killed During Operations

WS Directive 2.340 addresses requests for assistance associated with feral (an ownerless or homeless wild dog), free-ranging (dogs that have owners but not under the owner's direct control), or hybrid dogs (a canid that is the progeny of a domestic dog and a wild wolf or coyote that is either feral or free-ranging). In Colorado, the primary responder to damage caused by dogs is either a local animal control authority or the Colorado State Police. However, WS-Colorado can respond upon request for assistance with dogs to damage to agriculture, livestock, to protect human health or safety, and at airports and airfields, some of which may be caused by feral or free-ranging dogs.

WS-Colorado will conduct dog damage management in coordination with and after obtaining concurrence from State, local, or tribal authorities with jurisdiction over dog control, either by type of damage or on a case-by-case basis, as appropriate.

The primary concern, however, is when WS-Colorado field personnel incidentally take a pet dog while attempting to take another target species. APHIS-WS Directive 2.340 states: "Where WS personnel determine that a captured dog is a pet, WS personnel shall inform the land/resource owner as soon as is practicable….This policy does not in any way preclude WS personnel from appropriately defending themselves, their working animals, or restrained animals captured pursuant to official WS actions, from dog attacks." WS-Colorado field personnel take appropriate actions to avoid incidental take of pet dogs and do not set devices that could capture dogs in recreational areas whenever possible. All capture traps are set to minimize the risk of damage to the animal (Section 2.10). If the dog has identification allowing determination of the owner, the owner is informed as soon as possible. If not, then the dog is released on site.

There is no legal authority for financial liability against APHIS-WS personnel when operating consistent with federal and state law and APHIS-WS Directives.

1.19.6.8 PDM Should be Funded Through a State Head Tax

It is the policy of the Federal government that a livestock head tax for funding PDM must be established voluntarily and through authorities other than the Federal government. Although there is some interest in Colorado, this authority does not yet exist in the state. If a head tax were to be implemented, it would not necessarily change any federal funding for PDM. This issue is appropriately addressed through the political process at the state or county level.

CHAPTER 2. ISSUES AND ALTERNATIVES

2.1 What is Included in this Chapter?

This chapter describes:

- The issues which are evaluated in detail in Chapter 3;
- The issues which are not evaluated in detail in this EA, with rationale;
- The four alternatives evaluated in detail in Chapter 3, including continuing the current WS-Colorado PDM program (no action alternative);
- Alternatives which are not evaluated in detail in this EA, with rationale; and
- The protective measures that are incorporated into the relevant alternatives considered in detail that involve WS-Colorado operational activities.

2.2 What Are the Issues Analyzed in Detail in Chapter 3?

According to the Council on Environmental Quality (CEQ), NEPA documents should evaluate "*ecological…, aesthetic, historic, cultural, economic, social, [and] health*" effects. The analyses should also consider "*direct, indirect,* [and] *cumulative*" effects, as well as "*both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial*" (40 CFR 1508.8). WS-Colorado followed these CEQ regulations in the identification of issues to be analyzed. In addition, the chosen alternative should also accomplish the goals and objectives of APHIS-WS and WS-Colorado. Though not specifically required by NEPA or CEQ, this is an essential issue for the WS-Colorado decision-making process. It is included to evaluate program effectiveness and facilitate decision-making. The other issues described below have been identified based on APHIS-WS experience, previous APHIS-WS EAs, and public comments on those EAs. They are discussed here to provide context for the analyses of these issues in Chapter 3. The issues are:

- Issue A: Impacts on Populations of Target Species
- Issue B: Impacts on Populations of Non-target Species
- Issue C: Impacts on Ecosystem Function
- Issue D: Impacts on Human and Pet Health and Safety
- Issue E: Impacts on Use of Public Lands
- Issue F: Impacts on Other Sociocultural Issues

2.2.1 Issue A: Impacts on Populations of Target Species

This issue includes direct, indirect, and cumulative impacts on the populations of predator species targeted by WS-Colorado during PDM: coyotes, raccoons, red fox, striped skunk, black bears, mountain lions, feral cats, badgers, opossums, bobcats, swift fox, feral dogs, feral domestic ferrets, gray fox, western spotted skunk, long-tailed weasel, short-tailed weasel, marten, mink, ringtail, and gray wolf. The potential impacts of PDM on these species are largely direct impacts, but indirect impacts are also considered. Cumulative impacts include consideration of habitat, WS take, other consumptive uses, and natural sources of mortality.

2.2.2 Issue B: Impacts on Populations of Non-target Species

This issue includes direct, indirect, and cumulative impacts on the populations of various predator and prey species which are not targeted by WS-Colorado during PDM. This issue is further divided to assess impacts on (1) threatened and endangered species, and (2) other non-target species. All threatened and endangered species are considered, with detailed analyses of those determined by WS-Colorado to be potentially impacted by WS-Colorado's PDM activities. Other non-target species discussed are those recently taken by WS-Colorado during PDM, as well as those determined to be most likely to be taken in the future. These determinations are based on APHIS-WS experience, previous APHIS-WS EAs, and public comments on those EAs. These include predator species which may directly impacted due to non-target take, as well as prey species which may be indirectly affected by predator removal. Cumulative impacts include many factors such as habitat, WS take, other consumptive uses, indirect impacts of WS predator removal, and natural sources of mortality.

2.2.3 Issue C: Impacts on Ecosystem Function

This issue concerns the impacts on the ecosystem due to the removal of predators during PDM. This issue addresses complex interrelationships among trophic levels, habitat, biodiversity, and wildlife populations. These are inherently indirect and cumulative impacts. The analysis of this issue is limited to the larger picture of the ecosystem effects, as opposed to effects on any particular species' population; however, impacts on wildlife populations are included in this analysis to the extent that they may affect the ecosystem. Effects on species' populations are analyzed under issues A and B, described above.

2.2.4 Issue D: Impacts on Human and Pet Health and Safety

This issue considers the impacts of PDM by WS-Colorado on the likelihood of injury or illness to humans (both employees and the general public) and pets. For this EA, it is broken down into the following concerns:

- Potential exposure of WS-Colorado employees to disease from handling animals
- Potential for WS-Colorado employees, the public, or surface water to be exposed to hazardous chemicals (*e.g.*, lead, pesticides, immobilizing/euthanasia chemicals, and pyrotechnics)
- Potential for WS-Colorado employees or the public to be exposed to hazardous mechanical tools (traps, snares, and firearms)
- Employee crew safety during aerial PDM operations
- Risk of employees being attacked or bitten by captured animals
- Potential for impacts to communities, including consideration of Environmental Justice (E.O. 12898); and children (E.O. 13045)
- Potential for WS-Colorado PDM activities to impact pets (*e.g.*, due to non-target take)

This issue involves mostly direct or indirect effects, depending on the specific concern. For example, injury caused by a hazardous tool would be a direct impact, whereas surface water contamination would produce an indirect impact. Cumulative impacts are also considered, but are often not applicable, as will be discussed in Chapter 3.

2.2.5 Issue E: Impacts on Use of Public Lands

Recreation encompasses a wide variety of outdoor entertainment in the form of consumptive and non-consumptive uses. Consumptive uses of public lands include activities such as hunting, fishing, and rock-hounding. Non-consumptive uses include activities such as bird watching, photography, camping, hiking, biking, rock climbing, winter sports, and water sports. Recreationists are members of the general public that use public lands for one of the above or other activities. Some members of the public believe that WS-Colorado PDM activities conflict with recreation on public lands. In addition, some individuals believe their recreational experiences on public lands are impaired by knowing that any lethal PDM actions are occurring on these lands. Others feel that they are being deprived of the aesthetic experience of viewing or hearing coyotes or other predators because of WS-Colorado PDM actions. On the other hand, some believe that PDM is wholly acceptable. PDM can help bolster certain species populations of T&E species and big game, and eliminate individual predators that are a threat to human health and safety.

2.2.6 Issue F: Impacts on Other Sociocultural Issues

These issues include humaneness and ethics, as well as the impacts on cultural/historic resources. Impacts may be direct, indirect, or both, depending on the concern. Cumulative impacts are generally not applicable. In most cases, it is unlikely that actions taken by others would create additive or synergistic impacts. For example, the humaneness of a certain PDM technique is independent of any other humane or inhumane actions which may be taken by others.

2.2.6.1 Humaneness:

Humaneness and animal welfare as it relates to killing or capturing wildlife is an important and very complex issue that can be interpreted in a variety of ways. Schmidt (1989) indicated that vertebrate pest damage management for societal benefits could be compatible with animal welfare concerns if "the reduction of pain, suffering, and unnecessary death is incorporated in the decision making process." However, defining "pain" and "suffering" can be challenging. In fact, it has been noted that "neither medical nor veterinary curricula explicitly address suffering or its relief" (CDFW 1991). Suffering has been described as a "highly unpleasant emotional response usually associated with pain and distress." However, it has also been noted that suffering "can occur without pain" and that "pain can occur without suffering" (AVMA 1987). Suffering implies a duration of time; thus, an animal would experience "little or no suffering where death comes immediately" (CDFW 1991), such as from a well-placed gunshot. Defining pain is an even greater challenge. Wild mammals clearly experience pain, but detecting such pain can be difficult. Pain experienced by individual animals from the same stimulus probably ranges from little or no pain to significant pain (CDFW 1991). The American Veterinary Medical Association (AVMA) has also noted that "individuals can differ in their perceptions of pain intensity as well as in their physical and behavioral responses to it" (AVMA 2013). Altered physiology and behavior can be indicators of pain, and identifying the causes that elicit pain responses in humans would "probably be causes for pain in other animals" (AVMA 1987).

Stress has been defined as the effect of physical, physiologic, or emotional factors (stressors) that induce an alteration in an animal's base or adaptive state. Responses to stimuli vary among animals based on the animals' experiences, age, species, and current condition. Not all forms of stress result in adverse consequences for the animal, and some forms of stress serve a positive, adaptive function for the animal. Eustress describes the response of animals to harmless stimuli which initiates responses that are beneficial to the animal. Neutral stress is the term for response to stimuli which have neither harmful nor beneficial effects to the animal. Distress results when an animal's response to stimuli interferes with its well-being and comfort (AVMA 2007).

The AVMA defines euthanasia as *"the act of inducing humane death in an animal,"* and states that "*if an animal's life is to be taken, it [should be] done with the highest degree of respect, and with an emphasis on making the death as painless and distress free as possible*" (AVMA 2013). Additionally, euthanasia methods should minimize any stress and anxiety experienced by the animal prior to unconsciousness. Although use of euthanasia methods to end an animal's life is desirable, as noted by the AVMA, "*[f]or wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but terms such as killing, collecting, or harvesting, recognizing that a distress- free death may not be possible.*" (AVMA 2001).

AVMA (2013) notes that:

"[w]hile recommendations are made, it is important for those utilizing these recommendations to understand that, in some instances, agents and methods of euthanasia identified as appropriate for a particular species may not be available or may become less than an ideal choice due to differences in circumstances. Conversely, when settings are atypical, methods normally not considered appropriate may become the method of choice. Under such conditions, the humaneness (or perceived lack thereof) of the method used to bring about the death of an animal may be distinguished from the intent or outcome associated with an act of killing. Following this reasoning, it may still be an act of euthanasia to kill an animal in a manner that is not perfectly humane or that would not be considered appropriate in other contexts. For example, due to lack of control over free-ranging wildlife and the stress associated with close human contact, use of a firearm may be the most appropriate means of euthanasia. Also, shooting a suffering animal that is in extremis, instead of catching and transporting it to a clinic to euthanize it using a method normally considered to be appropriate (e.g., barbiturates), is consistent with one interpretation of a good death. The former method promotes the animal's overall interests by ending its misery quickly, even though the latter technique may be considered to be more acceptable under normal conditions (Yeates 2010). Neither of these examples, however, absolves the individual from her or his responsibility to ensure that recommended methods and agents of euthanasia are preferentially used."

AVMA (2013) recognizes that:

"[There is] an inherent lack of control over free-ranging wildlife, accepting that firearms may be the most appropriate approach to their euthanasia, and acknowledging that the quickest and most humane means of terminating the life of free-ranging wildlife in a given situation may not always meet all criteria established for euthanasia (i.e., distinguishes between euthanasia and methods that are more accurately characterized as humane killing). Because of the variety of situations that may be encountered, it is difficult to strictly classify methods for termination of free-ranging wildlife as acceptable, acceptable with conditions, or unacceptable. Furthermore, classification of a given method as a means of euthanasia or humane killing may vary by circumstances. These acknowledgments are not intended to condone a lower standard for the humane termination of wildlife. The best methods possible under the circumstances must be applied, and new technology and methods demonstrated to be superior to previously used methods must be embraced.

Multiple federal, state, and local regulations apply to the euthanasia of wildlife. In the United States, management of wildlife is primarily under state jurisdiction. However, some species (e.g., migratory birds, endangered species, marine mammals) are protected and managed by federal agencies or through collaboration between state and federal agencies. Within the context of wildlife management, personnel associated with state and federal agencies and Native American tribes may handle or capture individual animals or groups of animals for various purposes, including research. During the course of these management actions, individual animals may become injured or debilitated and may require euthanasia; in other cases, research or collection protocols dictate that some of them be killed. Sometimes population management requires the lethal control of wildlife species, and the public may identify and/or present individual animals to state or federal personnel because they are orphaned, sick, injured, diseased (e.g., rabid), or becoming a nuisance."

2.2.6.2 Wildlife Values and Ethical Perceptions of PDM

Ethics can be defined as the branch of philosophy dealing with values relating to human conduct with respect to the rightness or wrongness of actions and the goodness and badness of motives and ends. Individual perceptions of the ethics of PDM and the appropriateness of specific management techniques depend on the value system of the individual. These values are highly variable (Schmidt 1992, Teel *et al.* 2002), but can be divided into some general categories (Kellert and Smith 2000, Kellert 1994, Table 1-2). An individual's values on wildlife may have components of various categories and are not restricted to one viewpoint. The tendency to hold a particular value system varies among demographic groups.

Views on ethics of wildlife management also often contain an emotional component that can be variable depending on location and species being considered, can change over time, or can be inconsistent (Haider and Jax 2007, Littin *et al.* 2004). Various types of viewpoints can influence ethics and value systems. For example, one major factor influencing value systems is the degree of dependence on land and natural resources as indicated by rural residency, property ownership, and agriculture or resource dependent occupations (Kellert 1994). People in these groups tend to have a higher tendency for utilitarian and dominionistic values. Socioeconomic status also influences wildlife values with a higher occurrence of naturalistic and ecologistic value systems among college educated and higher income North Americans (Kellert 1994). Age and gender also influence value systems with a higher occurrence of moralistic and humanistic values among younger and female test respondents (Kellert 1984, 1994).

A recent study by (George *et al.* 2016) replicated the research of (Kellert 1984) evaluating human uses and values toward animals. The study found that favorable ratings for predators (coyotes and wolves) had increased since the study by Kellert with positive attitudes towards these species increasing 47% and 42% respectively and that overall attitudes towards wildlife appeared to be shifting from more dominionistic and utilitarian values to more mutualistic values in which the wildlife are viewed as part of an extended family deserving of caring and compassion and wherein the value of predators in ecosystems is valued. This shift is consistent with success of recent ballot measures intended to improve animal welfare through regulation of domestic animal housing standards and legislation banning or placing severe restrictions on use of devices such as foothold traps.

Individual relationships with the species in question still appear to influence attitudes towards wildlife. For example, Treves *et al.* (2013) found that public attitudes towards wolves may be increasingly negative among residents of areas occupied by wolves, especially those negatively impacted by wolves. Increasing urban residence has been increasingly associated with positive attitudes towards wildlife, and positive attitudes of this population likely outnumber opinions from more rural areas. However, like livestock producers in areas with wolves, attitudes of urban/suburban residents may be influenced by experiences in their area. George *et al.* (2016) noticed a decrease in positive attitudes towards raccoons and hypothesized that one of the potential reasons could be increased conflicts with raccoons (property damage, health and safety concerns) that are experienced in urban/suburban areas.

Many philosophies on human relationships with animals can be considered relative to ethical perceptions of PDM techniques. Some of the more prevalent philosophies are discussed here, although there may be others that influence wildlife management decisions.

One philosophy, animal rights, asserts that all animals, both human and nonhuman, are morally equal. Under this philosophy, no use of animals (for research, food and fiber production, recreational uses such as hunting and trapping, zoological displays, and animal damage management, etc.) should be conducted or considered acceptable unless that same action is morally acceptable when applied to humans (Schmidt 1989).

Another philosophy, animal welfare, does not promote equal rights for humans and nonhumans but focuses on reducing pain and suffering in animals. Advocates of this philosophy are not necessarily opposed to utilitarian uses of wildlife, but they are concerned with avoiding all unnecessary forms of animal suffering. However, the definition of what constitutes unnecessary is highly subjective (Schmidt 1989). In general, only a small portion of the U.S. population adheres to the animal rights philosophy, but most individuals are concerned about animal welfare.

A third philosophy takes the view that overpopulation of an animal species (whether natural, man-induced, or artificial) leads to increased animal suffering when the population suffers malnutrition, disease outbreaks of epidemic proportion, or populations crashes due to exceeding the environmental carrying capacity. Advocates for this approach suggest that it is man's obligation to manage animal populations in a manner that reduces potential suffering to a minimal level (Varner 2011). Similarly, some individuals may feel that humans have a moral obligation to correct environmental impacts that result from the human introduction of invasive species or species which have become extremely abundant due to their ability to thrive in human-altered environments.

2.3 What Issues Are Not Considered in Detail and Why?

The following issues are not considered in detail because they are outside the scope of this EA. The environmental consequences of these issues were found to have the least impacts under the current program alternative. Even though these issues are not analyzed in this EA, some of these issues are still considered in determining protective measures to reduce potential impacts. Following are the issues that were sufficiently discussed and show little or no change. Subsequently, these will not be addressed in this EA, except where protective measures are developed to minimize impacts of these issues.

2.3.1 The appropriateness of manipulating wildlife for the benefit of hunters or recreation.

Some individuals feel is this not appropriate to manipulate one wildlife species for the benefit of another wildlife species, or for the benefit of hunters or recreation. This is a matter of individual perception and perspective. The jurisdiction for managing most resident wildlife in the state rests with CPW which, under state law, can request WS assistance in achieving its management objectives. American Indian Tribes have jurisdiction for management of resident wildlife species on tribal lands and could also request such assistance. WS would not conduct PDM specifically for wildlife protection unless requested by an agency or tribe with such management authority.

2.3.2 WS's removal of coyotes exacerbates the livestock depredation problem because the coyote population reduction results in compensatory reproduction.

Although it is well supported that coyote reproduction increases as population size decreases (Connolly and Longhurst 1975), WS is unaware of any data that would substantiate the speculation that unexploited coyote populations pose less risk to livestock than exploited populations. On the contrary, research on lamb and sheep losses with restricted or no PDM indicate coyote control is effective in reducing losses. This is supported by a review of the Government Accounting Office (GAO 1990) which concluded that "according to available research, localized lethal controls have served their purpose in reducing predator damage (GAO 1990).

2.3.3 Cumulative Effects on Wildlife Populations from Oil and Gas Development, Timber Harvesting, Land Development, and Grazing.

A few public comments have been received during public review of prior versions of this EA that expressed concerns about cumulative impacts on the wildlife species that WS-Colorado impacts with PDM due to other activities such as oil and gas development, timber harvesting, other land development actions such as residential subdivision development, and grazing. WS-Colorado has no authority to affect decisions of other entities that engage in or approve such actions. Thus, they are not related or connected to WS-Colorado actions. The effects of such actions by other agencies and entities are part of the existing environmental baseline, and those effects neither increase nor decrease as a result of WS-Colorado PDM activities (see additional discussion about grazing impacts below).

Adverse impacts on some wildlife can result from land management and development activities. Housing developments in rural areas have been recognized as having adverse effects on wildlife by diminishing habitat (Gill 1999). Oil and gas development can adversely affect certain wildlife species by reducing the amount of available habitat for them. Road building and establishment of well pads (sites where wells are drilled to pump oil or gas out of the ground) reduce habitat directly by removing vegetation that animals use for food and cover. Timber harvest can benefit some wildlife species while negatively affecting others (USFS 1998). For example, deer and elk generally benefit from the creation of openings in large expanses of mature forest. Roads established to support oil and gas development and timber harvesting further indirectly reduce the amount of habitat "effectively available" to certain species because of animals' fear of using areas where humans are traveling; this is considered the "displacement effect" caused by roads. Wildlife species identified as being affected in this way include mule deer and elk.

The following discussion is provided to explain what potential, if any, WS-Colorado PDM actions have for contributing to cumulative effects on wildlife species and the environment that have resulted from non-WS related actions by others.

Where these activities occur on public lands, impact analysis is generally required under NEPA. Thus, our analysis focuses on public lands (BLM and USFS) where such activities occur, because there is sufficient data and analysis to effectively assess the potential for cumulative impacts. The BLM and USFS approve and regulate oil and gas development, timber harvesting, and grazing on public lands and have evaluated the potential for cumulative effects on numerous wildlife species because of their land management decisions for those types of activities. We reviewed BLM and USFS EIS documents for areas within Colorado to determine the species identified as being potentially impacted by land management activities (including oil and gas development, timber harvesting, and livestock grazing) and for which restrictions or mitigation measures have been established to minimize such impacts. These species are listed in Table 15. We refer the reader to those agencies and analyses to determine in more detail the extent of impacts of such activities on wildlife in specific areas. Then we made a determination of whether WS-Colorado PDM, including aerial PDM, has any real potential for contributing to or causing significant adverse impacts on any of those same wildlife species. The potential for WS-Colorado PDM activities, including aerial PDM, to affect these species is also included in Table 15.

In an EIS (BLM 1991) covering oil and gas leasing and development in 5 BLM RAs in Colorado, the BLM stated that indirect impacts on some wildlife species would be from the loss of 17,900 acres of habitat over a 20-year period because of ground surface disturbance which is minor compared to the 5.1 million acres of federal oil and gas mineral estate in the 5 RAs evaluated. Other impacts were qualitatively discussed but we could find no quantitative measures of such effects described. The BLM's Records of Decision for oil and gas leasing and development in the 5 RAs adopted a number of mitigation measures described in the EIS to protect wildlife habitat for the purposes of preventing substantial adverse effects on wildlife populations. The mitigation measures included habitat improvement efforts and stipulations or conditions on leases such as "Conditions of Approval", "No Surface Occupancy", and "Timing Limitations", each designed specifically to protect important wildlife habitat. The BLM concluded that cumulative impacts on wildlife from implementing their proposed oil and gas development proposed action would be insignificant (BLM 1991). Therefore, it appears that BLM has implemented effective mitigation measures to avoid significant adverse effects on wildlife from oil and gas development on BLM lands on the 5 RAs.

WS-Colorado PDM activities have not contributed, and are not expected to contribute, to adverse effects on most of the wildlife species affected by BLM and USFS land management decisions (Table 15; see Chapter 3 for analyses). This is partly because oil and gas development and timber harvesting typically do not affect the same wildlife resources that WS-Colorado PDM actions affect, and when they do, the effects are generally indirect and insignificant. Moreover, most of the impacts of these activities are due to habitat destruction or fragmentation, whereas WS-Colorado PDM has no effect on habitat. The only exceptions, with potential for cumulative impacts, are predator species targeted by WS-Colorado PDM, specifically coyotes, mountain lions, and black bears.

Coyotes, are directly affected by WS-Colorado PDM activities, but we found no mention of any concerns for the species in most BLM and USFS evaluations (cited above). Only one EIS (BLM 1999) cited a potential impact to coyotes, stating that small predators, including coyotes, would be impacted by oil and gas development because of habitat disturbance resulting in reductions of small mammal populations that are their primary source of prey. However, there is ample evidence in the scientific literature that coyote populations are not adversely impacted to any substantial degree by such land management actions. Coyotes are one of the most opportunistic, adaptable, and widely distributed predators in North America (Bekoff and Wells 1986). They have adapted to human land development (Howell 1982, Loven 1995), and have even expanded their range to more densely populated eastern states over the past several decades (Hill *et al.* 1987, Moore and Parker 1992). Thus, it is doubtful that coyote populations have indeed been negatively impacted to any significant degree by land management actions such as oil and gas development and timber harvesting, and we are aware of no studies that show potential for significant effect on them by such activities. Moreover, oil and gas development does not typically eliminate enough vegetation or disturb a high enough percentage of the ground surface area to remove substantial amounts of small mammal habitat (BLM 1999). Timber harvesting probably benefits coyotes by creating more open areas and "edge" habitat between wooded and open areas, and early successional stage areas that are generally conducive to supporting a variety of small mammal species that would serve as coyote and other small carnivore prey. More importantly and with more relevance here, the analysis in Chapter 3 herein shows that coyote populations in the state have been relatively stable and are expected to continue to be so despite any cumulative effects from all types of activities (related or not related to WS-Colorado PDM activities). Thus, there are no significant cumulative impacts on the coyote population in Colorado.

Mountain lions and black bears are the only other species that WS-Colorado directly affects with PDM, and which have been identified in at least one other agency's NEPA analysis as potentially being affected by these activities. Without explaining how or why, BLM (1991) stated that potential significant impacts from oil and gas activities on mountain lion and black bear populations would most likely be restricted to localized areas. BLM (1999) provided further explanation of potential effects on mountain lions and stated that indirect effects would be related to reductions in their principal prey species, primarily deer and elk, which may result from habitat loss that could occur as a result of oil and gas development. The most important type of habitat loss identified by BLM (1999) was the loss of deer and elk winter range[1]. Indeed, deer populations have been decreasing over the past 8 years, and habitat loss is thought to be a key factor. However, to our knowledge,

[1] Harsh winters with deep snow are frequently limiting factors in deer and elk populations, and lower elevation areas where these species can find adequate forage to meet their survival energy needs and reproductive nutrition requirements are critical to maintaining desired population levels in many areas of the western U.S.

mountain lion populations have not exhibited a concomitant decrease. In fact, our analysis suggests that mountain lion populations are increasing, or at least stable (see Chapter 3). This is consistent with the conclusions of the BLM (1991), in that they stated that any effects on mountain lions would most likely be limited to localized areas; their impacts were not expected to significantly affect mountain lions statewide. In addition WS-Colorado coyote removal activities on deer winter range areas could provide some positive or beneficial effect on deer by removing coyotes that can cause winter mortality or could otherwise cause added harassment stress on wintering deer (Mackie *et al.* 1976, Gese and Grothe 1995). We conclude that there is no cumulative impact on mountain lions due to the actions of WS-Colorado PDM, gas & oil exploration, and timber harvest, and we expect no cumulative impact on mountain lions due to these actions in the future.

2.3.4 Livestock Losses Are a Tax "Write Off".

Some people believe that livestock producers receive double benefits because producers have a partially tax funded program to resolve predation problems while they also receive deductions for livestock lost as a business expense on tax returns. However, this notion is incorrect because the Internal Revenue Service tax code (Internal Revenue Code, Section 1245, 1281) does not allow for livestock losses to be "written off" if the killed livestock was produced on the ranch. About 77% of predation occurs to young livestock (lambs, kids, and calves) in Colorado. Additionally, many ewes, nannies, and cows added as breeding stock replacements to herds from the lamb, kid, and calf crop, and if lost to predation they cannot be "written off" since they were not purchased. These factors limit the ability of livestock producers to recover financial losses. Producers do not receive double benefits from having a federal program to manage wildlife damage and collect federal tax deductions for predation losses.

2.3.5 Effects of Livestock Grazing on Riparian Areas and Wildlife Habitat as a "Connected Action" to WS's PDM Activities.

Some people have suggested that livestock grazing is “connected” to WS-Colorado PDM action, which implies that it either is an “interdependent part” of WS-Colorado PDM and depends on such PDM for its justification (*i.e.*, that it is “automatically triggered” by WS-Colorado PDM), or that it “cannot and will not proceed” unless WS-Colorado PDM occurs (40 CFR 1508.25). Both of these assertions are false. Livestock grazing in Colorado occurs on many private property areas, as well as on about 98% of BLM and USFS identified grazing allotments, without any WS-Colorado PDM actions conducted on those allotments in a given year. Therefore, livestock grazing is not automatically triggered by WS-Colorado PDM, and it clearly can and does “proceed” in the absence of WS-Colorado PDM assistance.

Although some persons may view WS-Colorado PDM actions as causing "indirect" effects on rangeland and riparian areas by facilitating the continuation of livestock grazing in such areas, such livestock grazing does currently take place, and there is no reason to think it will not continue to take place, even without assistance from the WS-Colorado program. For example, grazing occurs on about 98% of the BLM and USFS grazing allotments in the State without assistance from WS-Colorado on those allotments. Thus, the overwhelming majority of livestock grazing activity on federal public federal lands in Colorado is not receiving any WS-Colorado PDM assistance. Regulation or restriction of livestock grazing is outside the scope of decisions that WS-Colorado has authority to make. Thus, livestock grazing on all land ownership classes where it now occurs (private, State and federal lands), and whatever impacts there might be from such grazing, are part of the environmental baseline, whether or not WS-Colorado conducts any PDM activities.

Some public commenters have further asserted that WS-Colorado PDM to protect livestock cannot or will not proceed unless livestock grazing is occurring. Such an assertion is a tautology. If there were no livestock in this country, there would be no reason to use PDM protect livestock from predators. Just as there would be no reason to conduct PDM if there were no predators of livestock. Normally, PDM activities will occur wherever livestock producers experience predation losses, whether it is on private, state, or federal lands, and whether or not WS-Colorado is involved. Because federal agencies do not have the authority to regulate private land livestock grazing, such grazing and its effects are part of the existing human environment, and such private land livestock grazing is quite common and extensive.

Currently, livestock producers that request WS-Colorado PDM actions in Colorado must cover at least 50% of WS-Colorado's costs for providing the PDM service. Even if some livestock producers went out of business from the lack of receiving any PDM assistance and subsequent predation losses, livestock grazing may continue on those lands. Such producers may sell those ranches, including, any associated federal grazing permits, to other producers who may have better economic ability to withstand predation losses (*e.g.*, the purchasing producer has more cash to put toward operating expenses and does not have to pay as much in financing costs to borrow funds - this means a better "bottom line" for the new producer and better financial ability to remain in business even with some levels of predation loss). However, it is also possible that other such producers that go out of business may sell their properties to land developers, which can then lead to reductions in wildlife habitat because of rural land subdivision and residential housing construction. When that occurs, the inability to obtain adequate PDM services could have the unintended consequence of leading to reductions in wildlife species that formerly lived on, or otherwise depended on, the habitat that was lost to development. Loss of habitat because of human population growth and expansion of housing into traditional habitat areas has been a major concern cited by CPW in evaluating causes of long term declines in mule deer numbers since the middle part of the last century (Gill 1999).

Whether livestock grazing should occur on public lands (BLM and USFS) is outside the scope of this EA. The only livestock grazing activities that are subject to NEPA requirements are those that are authorized by federal land management agencies to occur on federal lands. The BLM and USFS prepare NEPA documents covering their authorizations of livestock grazing on public lands and we refer the reader to those agencies for further information and analysis of the environmental effects of grazing, including riparian areas. As stated earlier, PDM methods used by WS-Colorado have no direct effect on riparian areas, rangeland, or other types of habitat. Therefore, WS-Colorado PDM activities do not contribute to any cumulative impact on riparian areas or other habitat areas that are being affected or have been affected by livestock grazing.

However, livestock grazing does not have to be occurring on such lands to potentially result in the occurrence of PDM activities on those lands for the protection of livestock. This is because predators often have large home ranges, and will travel from an area of one land ownership where livestock may not be present into another area of land ownership where livestock are present in order to prey on the livestock. PDM could take place on public lands for the purpose of protecting livestock on nearby private lands.

Like livestock grazing and its impacts on the environment, PDM by nonfederal entities is part of the environmental baseline for the human environment in the absence of any federal PDM assistance and does not have to comply with the requirements and provisions of NEPA. However, such PDM actions by private or nonfederal parties could result in unacceptable and harmful impacts. For example, evidence suggests that some private entities will resort to illegal chemical pesticide uses in attempts to resolve real or perceived wildlife damage problems (USFWS 1996, Texas Department of Agriculture 2003, Porter 2004). We believe that professional assistance by a federal government agency operating under strict federal and state laws and government policies and guidelines is less likely to result in unintended adverse effects on the environment in general, and more specifically on non-target wildlife, and human health and safety than would private entities. This supposition is assessed in Chapter 3.

It is certainly reasonable to assume that PDM by State or private entities would occur in the absence of assistance by WS-Colorado. This means that even if someone asserts that WS-Colorado PDM for livestock protection is "connected" to public land grazing, WS-Colorado has no ability to affect the environmental outcome because most such grazing will continue to occur on public lands anyway, and at least some level of PDM will most likely occur also, in the absence of any action by WS-Colorado. Thus, even if WS-Colorado decided to select a "no WS program" alternative, such a decision would have virtually no meaningful effect in changing the environmental baseline with respect to the impacts of grazing and/or PDM actions. Federal land management laws all contain clauses protecting the rights of the States to maintain jurisdiction over the management of resident wildlife species.[2] It is our understanding that, unless regulated or restricted by the BLM or FS, authorized Colorado State agencies such as the CPW and CDA (or even private entities acting in accordance with State wildlife laws) could theoretically be authorized to control predators on BLM and FS lands in the absence of any involvement by WS-Colorado.

2.3.6 Potential Effects on Wildlife from the Mere Presence of WS Personnel Conducting PDM.

Public comments to prior versions of this EA have raised the concern that the mere presence of WS-Colorado personnel in the field during the spring months has the potential to cause harmful disturbance to wildlife, and could potentially cause some animals to be separated from their mothers or might cause the abandonment of nest sites. Professional wildlife biologists believe there is no basis for this speculation, especially considering the short duration WS-Colorado personnel spend in any particular area. There are fewer than 35 WS-Colorado field personnel in Colorado, which is only a tiny fraction of many thousands of public recreationists and other public land users that enter public lands in any one year as part of the existing human environment. WS-Colorado abides by all area closures imposed by State or federal land or wildlife management agencies to protect sensitive wildlife species. We rely upon annual coordination with those same agencies to alert us to areas where this is of particular concern. In general, few if any such concerns have been raised by the responsible agencies because WS-Colorado personnel only work in a small proportion of the land area and spend little time in any particular area.

2.3.7 Concerns that WS Employees Might Unknowingly Trespass.

Public comments to prior versions of this EA have raised the concern that WS-Colorado employees could trespass onto private property or across State boundaries both on the ground and in the air. WS-Colorado is aware that it is sometimes difficult to determine land ownership and boundary lines, and WS-Colorado field employees make diligent efforts to ensure that they do not enter properties where they do not have permission. Landowners who request assistance from WS-Colorado typically provide WS-Colorado representatives with very specific information not only about the property boundaries of their own land, but about the boundaries of neighboring lands as well. WS-Colorado aerial PDM activities are typically conducted with the aerial crew in radio contact with a WS-Colorado representative on the ground who knows the property boundaries of the area being

[2] Multiple Use and Sustained Yield Act of 1960, 16 U.S.C. § 528 (MUSYA) (stating that nothing in the act "shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish on the national forests"); Federal Land Planning Management Act, 43 U.S.C. § 1732(b) (emphasizing that "nothing in this Act shall be construed as * * * enlarging or diminishing the responsibility and authority of the States for management of fish and resident wildlife"). The National Forest Management Act of 1976 explicitly incorporated the MUSYA. 16 U.S.C. § 1604(e)(1). The Wilderness Act provides that "nothing in this Chapter shall be construed as affecting the jurisdiction or responsibilities of the several States with respect to wildlife and fish in the national forests." 16 U.S.C. § 1133(d)(7).

worked. Field staff and the aircraft often have GPS units loaded with property maps to aid in identifying work in being conducted on the ground. Therefore, we do not expect that inadvertent trespass incidents would rise to the level of presenting any significant environmental effects.

2.3.8 Concerns that the Proposed Action May Be "Highly Controversial" and Its Effects May Be "Highly Uncertain," Both of Which Would Require That an EIS Be Prepared

The failure of any particular special interest group to agree with every act of a Federal agency does not create a controversy, and NEPA does not require the courts to resolve disagreements among various scientists as to the methodology used by an agency to carry out its mission (*Marsh v. Oregon Natural Resource Council* 1989).

Also, as discussed in Section 1.15.2, disagreement with a particular federal action by any organization(s) or person(s) does not constitute controversy which would require the preparation of an EIS. In this context, "highly controversial" refers to controversy over the impact (whether the magnitude of the impact is in dispute), not controversy over the action(s) (*Hanly v. Kleindienst* 1972).

If a determination is made through this EA that the chosen action would have a significant environmental impact, then an EIS will be prepared.

Another concern commonly expressed in comments on this and prior EAs involves the degree to which the potential impacts are "highly uncertain or involve unique or unknown risks" (40 CFR §1508.27(b)(5)). Some commenters have claimed that uncertainty in any aspect of our analyses, including risks, requires the preparation of an EIS, based on the CEQ regulations at 40 CFR §1508.27(b)(5). However, this regulation states that such uncertainty or unique or unknown risks "should be considered" (40 CFR §1508.27(b)). The existence of any level of uncertainty, or unique or unknown risks, do not in themselves require a determination of significant impact. The degree of uncertainty, and the level of any unique or unknown risk must be evaluated. Throughout the analyses in Chapter 3 of this EA, WS-Colorado uses the best available data and information from wildlife agencies having jurisdiction by law (CPW and USFWS; 40 CFR §1508.15), as well as the scientific literature, especially peer-reviewed scientific literature, to inform its decision-making. Where there is uncertainty, we consider the level of uncertainty in our analysis and in our assessment of significant impact. Where risks may be unique or unknown, we consider this in our analysis and in our assessment of significant impact. If either of these factors would result in significant impact, our analysis in Chapter 3 will reflect that. Our analyses are in compliance with the CEQ regulations at 40 CFR §1508.27(b)(5).

2.3.9 Concerns that Killing Wildlife Represents "Irreparable Harm"

Public comments to prior versions of this EA have raised the concern that the killing of any wildlife represents irreparable harm. Although an individual predator or multiple predators in a specific area may be killed by WS-Colorado PDM activities, this does not in any way irreparably harm the continued existence of these species. Wildlife populations experience mortality from a variety of causes, including human harvest and depredation control, and have evolved reproductive capabilities to withstand considerable mortality by replacing individuals that are lost. Colorado's historic and current populations of big game animals, game birds, furbearers, and unprotected predators, which annually sustain harvests of thousands of animals as part of the existing human environment, are obvious testimony to the fact that the killing of wildlife does not cause irreparable harm. Populations of some of these species are in fact much higher today than they were several decades ago (*e.g.*, elk and black bears), in spite of liberal hunting seasons and the killing of hundreds or thousands of these animals annually. The legislated mission of CPW is to preserve, protect, and perpetuate all the wildlife of the State. Therefore, CPW would be expected to regulate the killing of protected wildlife species in the State to avoid irreparable harm. Our analysis in Chapter 3 shows that the species WS-

Colorado takes in PDM actions are expected to sustain viable populations. Thus, losses due to human-caused mortality are not "irreparable."

2.3.10 Global Climate Change/Greenhouse Gas Emissions

Global climate change is an important topic, which needs to be considered. However, we believe that it does not warrant consideration as an "Issue" for comparative analysis. We have considered the topic of global climate change, and our analysis is provided below.

The State of the Climate in 2012 report indicates that since 1976, annual average global temperatures have been warmer than the long-term average (Blunden and Arndt 2013). Average global surface temperatures in 2012 were among the top ten warmest years on record with the largest average temperature differences in the United States, Canada, southern Europe, western Russia and the Russian Far East (Osborne and Lindsey, 2013). Impacts of this change will vary throughout the United States, but some areas will experience air and water temperature increases, alterations in precipitation and increased severe weather events. The distribution and abundance of a plant or animal species is often dictated by temperature and precipitation. According to the EPA (2013), as temperatures continue to increase, the habitat ranges of many species are moving into northern latitudes and higher altitudes. Species adapted to cold climates may struggle to adjust to changing climate conditions (*e.g.*, less snowfall, range expansions of other species).

APHIS recognizes that climate change is an ongoing concern and may result in changes in species range and abundance. Climate change may also impact agricultural practices. The combination of these two factors over time may lead to changes in the scope and nature of wildlife-human conflicts in the State. Because these types of changes are an ongoing process, this EA has developed a dynamic system including mitigations and standard operating procedures that allow the agencies to monitor for and adjust to impacts of ongoing changes in the affected environment. WS-Colorado would monitor activities conducted under this analysis in context of the issues analyzed in detail to determine if the need for action and associated impacts remain within parameters established and analyzed in this EA. WS-Colorado would supplement the analysis and/or modify program actions in accordance with applicable local, State and federal regulations including the NEPA if substantive changes in the potential environmental effects of program actions warranting revised analysis are identified. Established protective measures also include reporting all take to the USFWS and CPW and CDA annually as appropriate for review of project-specific and cumulative impacts on wildlife populations. Coordination with agencies that have management authority for the long-term wellbeing of native wildlife populations and review of available data on wildlife population size and population trends enables the program to check for adverse cumulative impacts on wildlife populations, including actions by WS-Colorado that could jeopardize the long-term viability of WS-Colorado actions on wildlife populations. Monitoring would include review of federally-listed T/E species and consultation with the USFWS, as appropriate, to avoid adverse impacts on T/E species. As with any changes in need for action, WS-Colorado would supplement the analysis and/or modify program actions in accordance with applicable local, State and federal regulations including the NEPA, as needed, to address substantive changes in wildlife populations and associated impacts of the PDM program. In this way, we believe the proposed action accounts for is responsive to ongoing changes in the cumulative impacts of actions conducted in Colorado in accordance with the NEPA.

The CEQ has advised federal agencies to consider whether analysis of the direct and indirect greenhouse gas (GHG) emissions from their proposed actions may provide meaningful information to decision makers and the public (CEQ 2014). Based on their review of the available science, CEQ advised agencies that if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO2-equivalent GHG emissions on an annual basis the agencies should consider that a quantitative and qualitative assessment may be meaningful to decision makers and the public (CEQ 2014). APHIS has assessed the potential GHG impacts from the national APHIS-WS program and current and proposed actions in context of this guidance.

The average home produces 9.26 metric tons (MTs) of carbon dioxide equivalents (CDEs; includes CO_2, NO_x, CO and SO_x) annually (EPA 2017). Nationwide, APHIS-WS has 170 district and State Offices and this includes district offices (as of 2013) with only one staff person. Using the average home data from EPA (2017), we estimate that APHIS-WS produces approximately 1,574 MT of CDEs annually. Each State Office would likely produce fewer CDEs annually than the average home because little electricity is used at night and on weekends, so this estimate is likely to be conservative.

APHIS-WS vehicles are used for a multitude of wildlife management projects, including current Colorado PDM Program activities. APHIS-WS cannot predict the fuel efficiency of each all-terrain vehicle (ATV) used in the field nor can it predict how often an ATV would be used. However, if a conservative estimate of 20 miles per gallon is used and consideration is given to total mileage being substantially less than the mileage calculated for normal vehicular use, the effects of ATVs on air quality would be negligible. APHIS-WS also cannot predict the fuel efficiency of each vehicle in the national program. The Federal Highway Administration (FHWA 2017) estimated average fuel consumption per light duty vehicle at 475 gallons per year in 2015. APHIS-WS owned or leased 1,665 vehicles in 2013. The EPA (2017) uses 0.989 as the ratio of CDEs to total greenhouse gas emissions for passenger vehicles, and the EPA and United States Department of Transportation use the conversion factor of 8,887 grams of CO_2 per gallon of gasoline (75 Fed. Reg. 88, 25330). Using these data, vehicle use by all APHIS-WS programs nationwide might contribute approximately 7,109 metric tons (MT) of CDEs each year.[3]

Nationwide, APHIS-WS either owns or leases ten different types of helicopters; their average fuel consumption is 24.88 gallons per hour. Helicopters with this average fuel consumption emit approximately 0.24 MT/hour of CO_2 emissions (Conklin & de Decker 2017).[4] APHIS-WS also owns or leases six different types of fixed wing aircraft. Average CO_2 emissions from these types of aircraft is 0.11MT/hour (Conklin & de Decker 2017). Nationwide, APHIS-WS flew 10,426 hours (helicopter and fixed wing combined) of agency-owned aircraft in FY 2013 and flew an additional 4,225 hours under contract aircraft. If all 14,651 flight hours were attributed to fixed-wing planes, the estimated CO_2 emissions would be 1,612 MT/year. If all flight hours were attributed to helicopters, the estimated CO_2 emissions would be 3,516 MT/year.

Combining vehicle, aircraft, and office use for FY 2013, the range of CDEs produced by APHIS-WS is estimated to be between 10,295 and 12,199 MT per year, which is well below the CEQ's suggested reference point of 25,000 MT/year (CEQ 2014). These are cumulative data for APHIS-WS nationwide. WS-Colorado produces only a small portion of these emissions, and the WS-Colorado PDM activities analyzed in this EA produce an even smaller portion.

At least one commenter has suggested that WS should consider greenhouse gas emissions associated with livestock production as part of the emissions associated with the WS program. We do not concur that these emissions should be attributed entirely or in part to WS activities. The existence of the WS program is not essential to the survival of the livestock production industry and factors other than WS have been identified as the primary drivers for trends in the livestock industry. In a comparison of parts of the country with differing levels of coyotes and coyote predation on livestock

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[3] (8.89×10^{-3} MT/gallon of gasoline) x (475 gallons/vehicle) x (1/0.989) x (1,665 vehicles) = 7,109 MT of CDEs.

[4] Less than one percent each of NO_x, CO, SO_x, and other trace components are emitted from aircraft engine emissions (FAA 2005).

(Berger 2006) concluded that government support of the predation management had not prevented declines in the sheep industry and that production costs and market prices explained most of their model variations in sheep numbers. These findings are not surprising given that conflicts with predators are not spread out evenly among producers and that many producers have little or no issues with wildlife predation on their livestock. Additionally, livestock producers can and do take measures on their own to address predation on livestock without involvement of the WS program. Consequently, although WS actions are beneficial to individual producers, the size and extent of the livestock production industry as a whole is not dependent upon WS.

WS understands that climate change is an important issue. The WS program will continue to participate in ongoing federal efforts to reduce greenhouse gas emissions associated with program activities including compliance with Executive Order 1369 – planning for federal sustainability in the next decade.

Given the information above, none of the alternatives considered is anticipated to result in substantial changes that would impact national APHIS-WS greenhouse gas emissions. WS-Colorado PDM activities under the proposed action would have a negligible effect on atmospheric conditions, including the global climate. Therefore this issue will not be considered for comparative analysis.

2.3.11 APHIS-WS activities could conflict with ongoing wildlife field research:

Commenters on prior EAs written by APHIS-WS have raised concerns that APHIS-WS PDM activities could interfere with ongoing wildlife research being conducted by state or educational entities. WS-Colorado coordination with tribes, and federal and state land management agencies would typically identify such ongoing research, which would minimize potential conflicts. Such research occurring on USFS or BLM lands would also be identified during development of the Animal Damage Management Plan (ADM).

2.3.12 Accuracy of reporting take of target and non-target animals:

Commenters have questioned the accuracy of APHIS-WS recording of the number of target and non-target animals taken during field operations. All APHIS-WS personnel are required to accurately report their field activities and technical assistance work they conduct while on official duty in the MIS, including take of target and non-target animals (WS Directive 4.205). APHIS-WS supervisors are required to review recorded work tasks for accuracy and to monitor: (1) compliance with rules and regulations for the use of pesticides and other special tools and methods and (2) adherence to permits, regulations, laws and policies pertaining to APHIS-WS actions. The report prepared by the USDA Office of Inspector General (OIG) on its audit of the APHIS-WS PDM program reviewed the accuracy of recording field activities, among other issues (OIG 2015). The audit concluded that APHIS-WS was generally in compliance with all applicable laws. Of almost 30,000 entries in the management system, 98% were correct with discrepancies of 2% identified including both under- and over-reporting of take. APHIS-WS is committed to and actively addressing OIG recommendations intended to further reduce discrepancies.

2.4 Resources Not Evaluated in Detail and Why

In addition, the following environmental resources are not evaluated in detail in this EA because the agency has found that these resources are not adversely impacted by the APHIS-WS program and WS-Colorado operations, based on previous PDM EAs prepared in the Western United States and in Colorado. They will not be discussed further in this EA.

- ***Floodplains (E.O. 11988):*** WS-Colorado operations do not involve construction of infrastructure and would not impact the ability of floodplains to function for flood abatement, wildlife habitat, navigation, or other functions.

- ***Visual quality:*** WS-Colorado operations do not change the visual quality of a public site or area. Although physical structures may be recommended as part of technical assistance, they are not constructed by WS-Colorado and therefore not under the agency's jurisdiction.
- ***General soils*** (except for Issue E: lead contamination from the use of lead ammunition): WS-Colorado operations do not involve directly placing any materials into the soils or causing major soil disturbance. Soil disturbance is minimized because vehicles are used on existing roads and trails to the extent practicable and there is no construction proposed or major ground disturbance. Setting traps involves only minor surface disturbance, and equipment is set primarily in previously disturbed areas.
- ***Minerals and geology:*** WS-Colorado operations do not involve any contact with minerals or change in the underlying geology of an area.
- ***Prime and unique farmlands and other unique areas*** (except Issue F concerning wilderness and other special management areas)**:** WS-Colorado operations do not involve permanently converting the land use of any kind of farmlands or other unique areas.
- ***Air quality:*** WS-Colorado's emissions are from routine use of trucks, airplanes, and very limited use of harassment devices using explosives, and therefore constitute a *de minimis* contribution to criteria pollutants regulated under the Clean Air Act (See Section 2.3.16 for discussion of climate change).
- ***Vegetation***, including timber and range plant communities: WS-Colorado operations do not change any vegetation communities or even small areas of plants.
- ***Environmental effects of the loss of individual animals:*** Comments on previous PDM EAs have urged APHIS-WS to analyze the environmental impacts of the loss of individual animals. Under the current and proposed alternatives, an individual predator or multiple predators in a specific area may be removed through WS-Colorado PDM activities. All WS-Colorado PDM activities are conducted under the authorization of and in compliance with Federal and state laws and in coordination with CPW, CDA, and/or the USFWS, as appropriate. Although we recognize that some individuals might find this loss distressing, the loss of an individual animal does not significantly impact the environment in any way. The possible exception is endangered species, for which the loss of a single animal may be significant to the population. In these cases, such impacts are considered under Issue B: impacts on populations of non-target species. Humaneness and ethics are considered under Issue F (Socioeconomic Issues), and this analysis does apply to each individual animal taken, whether lethally or non-lethally.

2.5 What Alternatives Are Considered in Detail in this EA?

Four alternatives are evaluated in detail in this EA, including continuation of the current WS-Colorado PDM program. They are described in Sections 2.6-2.9 below. These alternatives address WS-Colorado PDM activities only. For other APHIS-WS and WS-Colorado NEPA documents, including those open for public comment, please see:
https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/programs/nepa/ct_nepa_regulations_assessments. The alternative considered in detail are:

- Alternative 1 - Proposed Action/No Action Alternative - Continue WS-Colorado PDM Program
- Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.
- Alternative 3 – WS-Colorado Provides Technical Assistance Only
- Alternative 4 – No WS-Colorado PDM Program

The potential impacts from these four Alternatives are analyzed in Chapter 3. The effectiveness of each of these alternatives in addressing APHIS-WS and WS-Colorado goals and objectives is also evaluated in Chapter 3. Alternatives which were determined not to be reasonable, practical, or effective are described in Section 2.10, with the rationale provided for not evaluating each one in detail. Protective measures and APHIS-WS policies for addressing the Issues analyzed in this EA are listed in Section 2.11. These are incorporated into all alternatives which include WS-Colorado activities, as applicable.

2.6 Alternative 1: Continue the Current Federal Integrated Predator Damage Management Program (No Action/Proposed Action)?

2.6.1 Why is the Proposed Action Also the "No Action" Alternative?

In its 40 Most Asked Questions regarding the consideration of the "no action" alternative for project- and programmatic-level NEPA reviews, CEQ (1981) states:

> "*In situations where there is an existing program, plan, or policy, CEQ expects that the no-action alternative …would typically be the continuation of the present course of action until a new program, plan or policy is developed and decided upon*."

Some commenters to prior EAs have interpreted the "no action" alternative to be an alternative in which no action is taken by the federal Agency. However, APHIS-WS is required to follow CEQ guidance on this topic. Therefore, the current program, with natural fluctuations in PDM actions, locations, and tempo, is also the "no action" alternative. The impacts of all other alternatives considered in detail will be compared to the impacts of the current program.

2.6.2 How Do WS-Colorado Field Personnel Select a PDM Strategy Using the APHIS-WS Decision Model?

For all alternatives in which WS-Colorado provides requested services, WS-Colorado uses the APHIS-WS Decision Model (Figure 2.5.1.2; WS Directive 2.201) for evaluating the situation and determining the most effective strategy to address the situation.

The Decision Model is not a written documented process for each incident, but rather a mental problem-solving process. This process is similar to adaptive management strategies used by all wildlife management professionals when addressing a wildlife damage problem, including biologists who work for some of the lead and cooperating agencies for this EA. To use an analogy, it is also similar to assessment processes used by fire departments when they arrive on a scene to determine the most effective and safe strategy for resolving the situation.

Under the Decision Model, and by agency directive and policy, WS-Colorado field personnel assess the problem and evaluate the appropriateness of available damage management strategies and methods based on biological, economic, and social considerations. Following this evaluation, methods deemed to be practical and effective for the situation are incorporated into a management strategy. After the selected strategy has been implemented, the property owner monitors and evaluates the effectiveness, sometimes with WS-Colorado assistance. If needed, management strategies are then adjusted, modified, or discontinued, depending on the results of the evaluation.

The thought process and procedures of the Decision Model include the following steps (Figure 2-1):

(1) **Receive Request for Assistance:** WS-Colorado only provides assistance after receiving a request for such assistance. The employee can respond by providing professional technical assistance, information, recommendations, and advice at any time, on-site or through verbal or written communication. If the requester needs further on-site active assistance, the WS-

Colorado specialist and the requester will agree to the level of service and enter into a work agreement.

(2) **Assess Problem:** Once on site, the WS-Colorado field specialist makes a determination as to whether the assistance request was within the authority of WS-Colorado. If an assistance request is determined to be within agency authority, the specialist gathers and analyzes damage information in the field to determine applicable factors, such as what species was responsible for the damage, the type of damage, and the magnitude of damage. Other factors that WS-Colorado's employees often consider include the current economic loss or current threat, such as the threat to human safety, the potential for future losses or continued damage, the local history of damage in the area, environmental considerations, and what management methods, if any, were used to reduce past damage and the results of those actions.

(3) **Evaluate Management Methods:** Once a problem assessment is completed, the field specialist conducts an evaluation of available management methods to recommend the most effective strategy, considering available methods in the context of their legal and administrative availability; and their acceptability based on biological, environmental, social, and cultural factors.

(4) **Formulate Management Strategy:** The field specialist formulates a management strategy using those methods that the employee determines to be practical and effective for use, considering additional factors essential to formulating each management strategy, such as available expertise, willingness of the property owner, legal constraints on available methods, costs, and effectiveness. In many cases, the methods included in a strategy work in concert to produce the best result; this is the advantage of using an integrated strategy instead of a list of methods.

(5) **Provide Assistance:** After formulating a management strategy, technical assistance and/or direct operational assistance to the requester is provided as appropriate (see WS Directive 2.101).

(6) **Monitor and Evaluate Results of Management Actions:** When providing direct operational assistance, effectiveness of the management strategy is monitored, primarily by the cooperator, with assistance by WS-Colorado when appropriate. Monitoring is important for determining whether further assistance is required or whether the management strategy resolved the problem and if additional work is necessary.

(7) **End of Project:** When providing technical assistance, a project normally ends after the WS-Colorado field specialist provided recommendations and/or advice to the requester. A direct operational assistance project normally ends when WS-Colorado's field specialist is able to eliminate or reduce the damage or threat to an acceptable level to the requester or to the extent possible. Some damage situations may require continuing or intermittent assistance from WS-Colorado and may have no well-defined termination point, as work must be repeated periodically to maintain damage at a low level, such as coyote control to protect livestock (over time, other coyotes often move in to occupy the territory of the removed coyotes), or safety operations at airports.

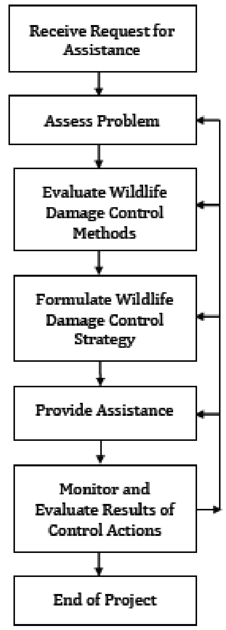


Figure 2-1. APHIS-WS Decision Model (WS Directive 2.201).

2.6.3 What is the Process for Verifying Losses and Damage?

Conflicts with predators can be in the form of a threat of damage, and/or damage that has or is currently occurring. Damage threats include an area with a history of livestock depredation, or an area where predators are known to exist, and there is ample reason to expect damage. Damage reported to WS-Colorado, such as predation or injury, is recorded in the APHIS-WS MIS database as "reported" damage. If employees are able to verify that the damage occurred, it is recorded in MIS as "verified" damage (defined as resource or production losses examined by a WS-Colorado specialist during a site visit and determined to have been caused by a specific predator species). Confirmation of the species that caused the damage and the extent of the problem are important steps toward establishing the need for implementing the PDM activities, and the methodologies that will be most effective to resolve the problem.

Several factors can increase the complexity of determining whether a depredation event occurred and, if so, which species is responsible for the damage. Responding to a request in a timely manner is critical in order to view the scene and livestock remains before they become degraded or obscured. The "scene" can include evidence of a struggle, hair, scat, tracks, or wounds on an animal, which may be indicative of a particular predator's method of attacking livestock or wild animals. Many factors, including consumption of the remains from a predator or other scavengers, natural decomposition, and local climate variables, can impact the condition of the livestock remains and make it harder for WS-Colorado personnel to determine the predator species responsible.

Field employees carefully examine the surrounding area and often perform a field necropsy to observe or collect evidence, such as bite/claw marks, trauma, and hemorrhaging. Natural causes of death, such as injury, illness, and animal health are also considered during the necropsy.

The location of the dead animal and how it is oriented can help determine the offending species, because predator species have typical patterns or ways that they kill their prey. Occasionally there is sufficient evidence to conclude that depredation did occur, but insufficient information to make a determination as to which predator species was involved. For example, there may have been visual signs of a struggle, blood trails, and some tissue remaining that shows sign of hemorrhaging, but not enough tissue left to know which species caused it. The predator and, potentially, scavengers may eat most of the carcass. When insufficient evidence remains, or the carcass or scene is unable to be verified, the loss is considered to be *reported* and the species most likely to have caused the damage is recorded in the MIS database. Employees use their experience and the information available to make the best determination of the species involved in the depredation, when possible, and take action as warranted and in accordance with APHIS-WS policy and state and federal law.

In most cases, when addressing livestock depredation, WS-Colorado field personnel do not attempt to locate every depredated carcass reported by ranchers, but attempt to verify sufficient levels of damage to establish the need to take action and develop the appropriate strategy using the Decision Model. Therefore, in many cases, damage reported by WS-Colorado does not actually reflect the total number of livestock or other resource affected, but provides an index of the annual damage occurring and sufficient information to develop the management strategy. Because producers experiencing loss may or may not contact WS-Colorado to report their losses or to request assistance, even fewer instances of depredation are documented. Producers often try to resolve the damage themselves or may request assistance from other entities (Section 1.6).

2.6.4 Background to the Proposed Action/No Action Alternative

A major goal of the WS-Colorado program is to resolve and prevent damage caused by predators and to reduce threats to human safety. To meet this goal, WS-Colorado responds to requests for assistance with technical assistance and/or operational assistance to entities that enter into an agreement with WS-Colorado. APHIS-WS activities are funded by both Congressional appropriations and funds provided by entities that enter into agreements with APHIS-WS state offices.

To be most effective, PDM activities should begin as soon as predators begin to cause damage or are expected to begin to cause damage, such as in the spring during coyote pupping, and while livestock are simultaneously lambing or calving. Waiting until damage is ongoing may make the problem more difficult to resolve, because individual animals become conditioned to an area and familiar with a particular location. As such, WS-Colorado works closely with those requesting entities to identify situations where damage is likely to occur, and WS-Colorado personnel implement or recommend effective methods as early as possible.

WS-Colorado also continues to work with NWRC and other professional entities to produce and distribute materials and provide educational programs on methods for preventing or reducing predator damage.

2.6.5 In General, How Does WS-Colorado Perform PDM Activities Under Alternative 1?

The current WS-Colorado PDM approach is an integrated PDM approach, using a variety of non-lethal and lethal methods, as described above. The general components of the WS-Colorado PDM program are described below. The specific methods are described in detail in Appendix A.

- **Collaboration and Project Identification**

  WS-Colorado enters into cooperative partnerships in all aspects of operational WDM when requested by agency partners, tribes, and private entities. These projects are initiated and funded (partially and/or wholly) by partner agencies, tribes, and other cooperators who have experienced predator damage, or are working on research pertaining to PDM. Cooperative partnerships are developed to implement PDM in specified areas for the protection of targeted resources as discussed in Chapter 1.

- **Technical Assistance**

  WS-Colorado provides information to property owners and managers upon request regarding the use of effective, safe, and practical non-lethal and lethal techniques and/or integrated PDM strategies. Such technical assistance includes advice, training, and, to a limited degree, loaning of equipment. Technical assistance is described in detail in Appendix A.

  Property owners or managers may choose to implement WS-Colorado's technical assistance recommendations on their own, use contractual services of private businesses, use volunteer services of private organizations, use the services of WS-Colorado (operational assistance), take the management action themselves, or take no action.

- **Operational Assistance**

  WS-Colorado uses an integrated PDM approach using the Decision Model, as described in Section 2.6.2, which includes a variety of non-lethal and lethal methods. These methods are described in detail in Appendix A. When a requester chooses to contract with WS-Colorado to conduct PDM activities on their behalf, WS-Colorado employees will provide these services whenever they are legal, warranted, safe, and effective. When WS-Colorado employees conduct PDM activities, whether non-lethal or lethal, this is considered Operational Assistance. In most cases, WS-Colorado provides a combination of technical assistance and operational assistance. Often, non-lethal recommendations provided by WS-Colorado are conducted by the resource owners, because it is logistically or economically more practical. These same resource owners may contract with WS-Colorado to conduct lethal PDM, because they find it to be safer, more effective, and/or more cost-effective.

- **Corrective (Reactive) Predator Damage Management**

  Corrective PDM is the use of non-lethal and/or lethal methods in response to current or ongoing damage, in an effort to prevent additional damage from occurring. This may also be referred to as reactive PDM. Corrective PDM is conducted in any area where current damage is reported or verified, and where damage is reasonably expected to continue in the absence of PDM. The purpose of corrective PDM is not to punish the predator(s) causing the damage; the purpose is to stop the damage. According to APHIS (2017l):

  "Corrective Damage Management is applying management strategies to stop or reduce current losses. As requested and appropriate, WS personnel provide information, conduct demonstrations, or take action to prevent future additional losses. Corrective actions may include a combination of… wildlife damage management approaches, technical assistance, and operational damage management assistance."

  Resource managers and others requesting operational assistance are provided with information regarding the use of effective nonlethal and lethal techniques, including recommendations as to effective long-term strategies for reducing risk of wildlife damage. When appropriate, WS-Colorado also provides operational assistance using lethal and non-lethal methods within an integrated PDM strategy.

  For example, in an area where coyotes are currently depredating sheep, a WS-Colorado field specialist may provide information about livestock guarding animals, fencing, or husbandry techniques. If these techniques are already in use, or fail to stop the damage, WS-Colorado may recommend or conduct lethal PDM in an attempt to remove the coyotes which are causing the damage. This may result in a temporary reduction in the local coyote population. However, other coyotes will likely immigrate into the area to re-fill this niche, such that the local coyote population would not be affected in the long-term. The goal is to provide relief from damage without affecting the local coyote population in the long-term, or affecting statewide coyote populations.

- **Preventive (Proactive) Damage Management**

  Preventive PDM is the use of non-lethal and/or lethal methods before expected damage occurs, in an effort to prevent the damage from occurring. Preventive PDM is generally conducted in areas where damage or conflict has historically occurred, and it is reasonable to expect future damage at that location. According to APHIS (2017l):

  > *"Preventive Damage Management is applying management strategies before damage occurs, based on historical problems and data. Many resource management strategies and physical exclusion methods are intended to prevent damage from occurring. For example, fencing is often used to keep predators out of livestock pastures to prevent predation. When requested, WS personnel provide information and conduct demonstrations, or take action to prevent future losses from recurring."*

  WS-Colorado responds to resource owners and managers in the same fashion as for corrective PDM, as described above. The main difference between preventive PDM and corrective PDM is the timing of the PDM action compared to the timing of the damage. In corrective PDM, the action is taken soon after the damage; in preventive PDM, the action is taken much later. In both cases, the goal is the same: to stop or mitigate future damage.

  For example, in a location where coyotes have caused substantial calf depredation on calving grounds in prior years, WS-Colorado may recommend livestock guarding animals, fencing, or other husbandry techniques. If these techniques are already in use, are impractical, or fail to stop the damage, WS-Colorado may recommend or conduct lethal PDM to remove some of the coyotes in the area just before calving begins. This can result in a short-term reduction in the local population of predators. When properly timed and applied, this provides relief from damage without affecting the local coyote population in the long-term, or the statewide coyote population.

  Both of these approaches (corrective and preventive PDM) underscore the differentiation between "predator management" and "predator damage management" discussed in Chapter 1. The goal is not to manage predators, or their populations. The goal is to manage the damage caused by the predators, without affecting their population(s).

- **Carcass Disposal**

  WS-Colorado does not bury carcasses taken during land-based operations. Unless otherwise regulated by Colorado law, WS-Colorado disposes of them on land by moving them out of view into a brush pile, placing them in existing carcass pits on private property, and occasionally disposing of them in designated landfills or transfer stations when other methods are not feasible or available. Animals taken during aerial operations are seldom recovered because it is not always safe to land aircraft in the field, and it is seldom cost-effective or time-effective to direct ground personnel to the carcasses for recovery. Occasionally, the carcasses may be recovered in order to collect samples to test for diseases or for other research. In these cases, the carcasses are disposed of as for land-based operations.

  All carcass disposal is consistent with APHIS-WS Directives 2.510 and 2.515 and state law.

- **Monitoring**

  WS-Colorado, in coordination with CPW when appropriate, monitors the results and impacts of its program. The impacts discussed in this EA are regularly monitored and evaluated in two ways:

  1) WS-Colorado determines if any additional information that arises subsequent to the NEPA decision from this EA would trigger the need for additional NEPA analysis. WS-Colorado reviews implementation results and the related NEPA documents, as needed, to ensure that the need for action, issues identified, alternatives, regulatory framework, and environmental consequences are consistent with those identified in this EA.
  2) WS-Colorado monitors impacts on target and non-target predator populations through its MIS database. The MIS information is used to assess the localized and cumulative impacts of WS-Colorado activities on specific target predator and non-target wildlife populations. WS-Colorado provides detailed information on animals removed, as appropriate, to CPW to assist with managing species and resources under their jurisdiction.

2.6.6 What Methods Will Be Used by WS-Colorado under Alternative 1?

WS-Colorado uses and/or recommends a variety of non-lethal and lethal methods, including combinations of methods, for integrated PDM strategies. Detailed descriptions of non-lethal and lethal methods are provided in Appendix A; brief summaries are included below.

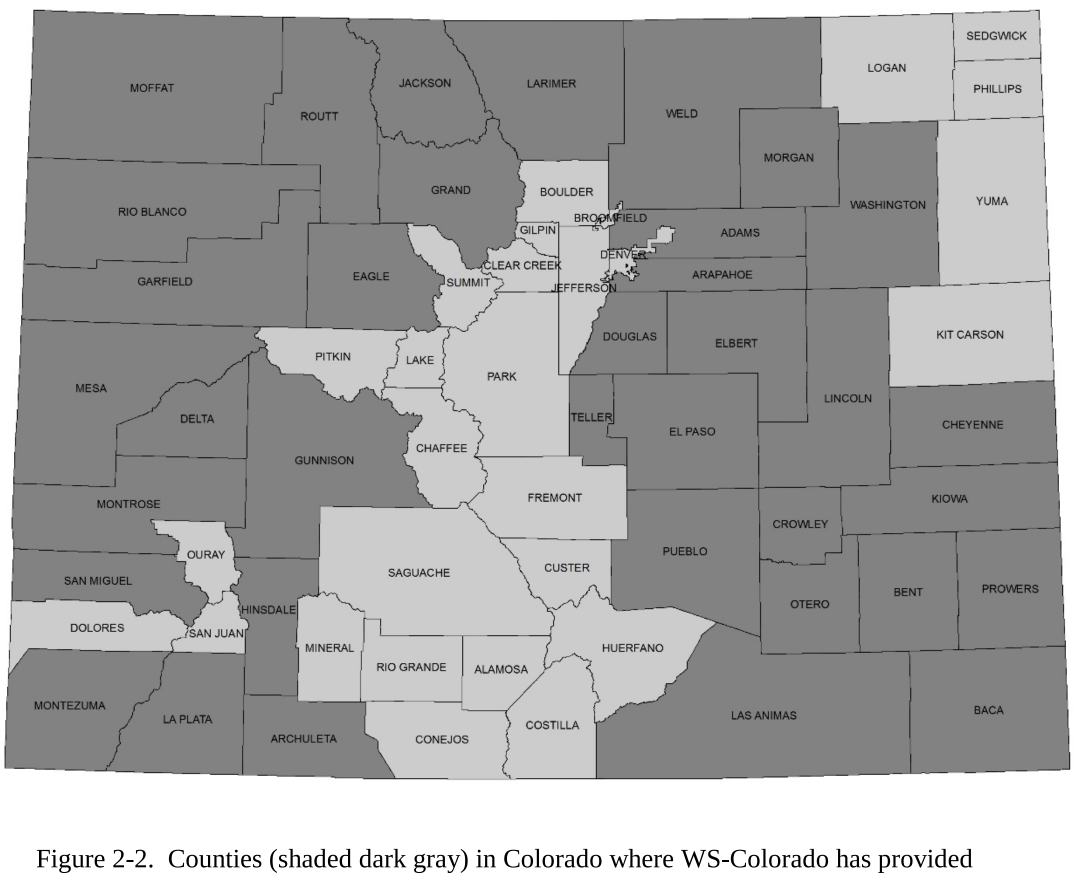


Figure 2-2. Counties (shaded dark gray) in Colorado where WS-Colorado has provided services to reduce predation on livestock from coyotes, black bears, mountain lions and red fox during Federal Fiscal Year 2012 to 2016, and where it could do so in the future under Alternative 1.

- **Non-lethal methods**

  Non-lethal methods can be used to disperse, prevent or restrict access, or otherwise make an area unattractive to predators causing damage, thereby reducing the risk that predators will cause damage or threats. Non-lethal methods are given priority by WS-Colorado field specialists when addressing requests for assistance, when applicable and effective (WS Directive 2.101). However, non-lethal methods are not necessarily recommended for every problem; they may be deemed inappropriate or ineffective by WS-Colorado personnel under the Decision Model as described earlier (Section 2.6.2, Figure 2.1). WS-Colorado personnel may also recommend that lethal methods be used initially to resolve the immediate problem while non-lethal methods are implemented, such as fence construction.

  Non-lethal methods used or recommended by WS-Colorado may include habitat management, husbandry, hazing, fencing, fladry, aversive/harassment devices, herding, moving livestock, range-riders, and livestock guard animals (Appendix A). WS-Colorado may occasionally loan harassment equipment such as propane cannons and pyrotechnics to livestock producers. Most non-lethal methods are implemented by the property owners or managers, because it is generally more logistically feasible or cost-effective. For example, it would be impractical to ask WS-Colorado employees to alter husbandry practices. This is more logically done by the property manager or their employees/contractors—the people who are in charge of, or are conducting those practices. Many of these methods require regular maintenance and/or human presence to be effective. For dispersing predators, proper timing is essential. Using methods soon after damage begins or soon after threats are identified increases the likelihood of success.

  In most situations, a cooperating entity has already attempted various non-lethal methods to resolve damage, prior to contacting WS-Colorado for assistance. In those cases, the methods used by the requester were either wholly unsuccessful, or ineffective at reducing the damage/threats to a tolerable level. Accordingly, WS-Colorado employees might recommend other, more effective non-lethal methods; more effective implementation strategies for the current non-lethal methods; and/or lethal methods.

- **Lethal methods**

  In order to reduce the likelihood of additional damage, lethal methods are often used to reinforce non-lethal methods, to remove animals that have been identified as causing damage or posing a threat to human safety, and/or when non-lethal methods are deemed to be impractical or ineffective. Because non-lethal methods are generally conducted by the resource owner/manager, when WS-Colorado operational assistance with PDM is requested, it is general for lethal PDM. The number of animals removed from the area using lethal methods under this alternative is dependent on the number of predators involved with the associated damage or threat, the potential for reoccurrence of depredation, and the effectiveness of methods used.

  Lethal methods used by WS-Colorado employees include ground shooting; aerial PDM; snaring; live-trapping, such as using snares, nets, cage traps, and foothold traps (followed by mechanical or chemical euthanasia in the case of lethal removal); or chemical toxicants. These methods are described in detail in Appendix A. WS-Colorado employees follow the American Veterinary Medical Association (AVMA 2013) euthanasia recommendations for free-ranging and captured animals in program activities, where practical and effective (APHIS-WS Directive 2.505, and Sections 2.6 and 3.1), and use the most humane and rapid methods available under the circumstances and per the Decision Model (Sections 2.6.2, Appendix A, and Section 3.6).

Aerial PDM with fixed-wing aircraft is generally one of the most effective control methods where terrain is relatively flat, and it is the preferred method because of its selectivity, accessibility, effectiveness, and ability to cover rough terrain, especially during winter weather. In addition, it provides the greatest area of coverage needed to protect livestock resources. Other control methods, such as foothold traps, snares, M-44s, and ground shooting, are also used in combination with aerial PDM in these areas. During spring, coyotes inflict the greatest predation losses coinciding with lambing and calving. Therefore, PDM is intensified in winter and early spring, using all necessary methods including aerial PDM, traps, snares, M-44s, and shooting.

Good visibility and relatively clear and stable weather conditions are required for effective and safe aerial PDM operations. Summer conditions limit the effectiveness of aerial PDM, because heat reduces coyote activity, and vegetative ground cover greatly hampers visibility. High temperatures, which reduce air density, affect low-level flight safety and may further restrict aerial PDM activities. Other conditions which impede aerial PDM include high elevation, dense vegetative cover, and rugged terrain.

Table 2-4. Lethal predator damage management methods available for use by Wildlife Services and private entities in Colorado.

	Wildlife Services			Private Entities		
Method[1]	**Federal Public Lands**	**State Public Lands**	**Private Lands**	**Federal Public Lands**	**State Public Lands**	**Private Lands**
Aerial PDM	Yes	Yes	Yes	No	No	Yes
M-44	No	No	Yes	No	No	No
Large Gas Cartridges	Yes	Yes	Yes	No[2]	No[2]	No[2]
Foot-hold Traps	Yes[3]	Yes[3]	Yes[3]	No	No	Yes[3]
Snares (body or neck)	Yes[3]	Yes[3]	Yes[3]	No	No	Yes[3]
Shooting	Yes	Yes	Yes	Yes	Maybe[4]	Yes
Thermal Imager	Yes	Yes	Yes	Maybe[5]	Maybe[4,5]	Maybe[5]
Night Vision	Yes	Yes	Yes	Maybe[5]	Maybe[4,5]	Maybe[5]
Cage Trap	Yes	Yes	Yes	Yes	Maybe[4]	Yes
Dogs (decoy, bay, or tree)	Yes	Yes	Yes	Yes[6]	Maybe[4,6]	Yes[6]

[1] Several methods can be lethal or nonlethal, depending on what is done with the animal after contact.
[2] Method not permitted per Colorado Parks and Wildlife policy on pesticide use by private individuals.
[3]Method may be used under Amendment 14 to protect agriculture, human health and safety, or research. Method may also be used on private and federal lands to protect federal threatened or endangered species.
[4] Use of dogs, traps, and firearms on Colorado Parks and Wildlife lands by private individuals allowed only in conformance with state hunting seasons and license restrictions.
[5] Cost may be prohibitive for individuals or small companies. Thermal imagers start at $13,000; night visions starts at %500-$3,000 depending on the image quality.
[6] Private entities may use dogs for bear and mountain lion damage management if permitted as an agent of Colorado Parks and Wildlife or livestock producer.

Aerial PDM is conducted only on lands where it is authorized and when under agreement, primarily on private lands. Most aerial PDM is conducted between late fall and early spring (November through March), because that is when it is most effective, and when most requests are received.

Aerial PDM can also be conducted by other entities under permit from CDA to remove coyotes and foxes for livestock protection.

Any strategy involving the removal of predators during a regulated hunting/trapping season is regulated by CPW as authorized by state law.

The current WS-Colorado program is or may be conducted on private, public, tribal, and other lands where a request has been made, the WS-Colorado employee has determined that the problem is caused by a predator, and appropriate agreements for assistance have been finalized. All management actions comply with appropriate federal, state, territorial, tribal, and local laws.

- **Methods which May Be both Lethal and Non-Lethal**

  Some methods may be part of either a lethal or non-lethal strategy, or a combination of both. For example, foothold and cage traps may be used to capture animals for translocation or for euthanasia, depending on the circumstances, species, policy and regulatory requirements, and management objective. CPW policy prohibits translocating certain species of predators, such as coyotes, skunks and raccoons, because they may spread disease, create the same problem in their new location, or not fare well due to stress and inter- and intraspecies competition. APHIS-WS policy also discourages translocation of captured offending animals for the same reasons (APHIS-WS Directive 2.501). Translocation of captured problem animals is also opposed by the American Veterinary Medical Association, the National Association of State Public Health Veterinarians and the Council of State and Territorial Epidemiologists due to the risk of disease transmission among wild mammals. This is particularly true for mesopredators such as raccoons or skunks (Center for Disease Control 1990). The State of Colorado Therefore, many animals captured using non-lethal methods are euthanized per state and APHIS-WS policy.

- **Protective Measures**

  See Section 2.11 for list of protective measures, including APHIS-WS Directives, state law and regulation, ESA terms and conditions, and other measures pertinent to this alternative.

2.6.7 How Does WS-Colorado Use Predator Damage Management to Protect Agriculture?

Upon receiving a request from a farmer, livestock producer, or livestock association, WS-Colorado uses the WS Decision Model to determine the best course of action. If operational assistance is warranted, WS-Colorado develops an operational plan, enters into an agreement with the requester, and implements the plan. This includes the complete array of non-lethal and lethal methods described in Appendix A. Operational programs to protect livestock and crops would include various live-capture and lethal removal techniques, including aerial PDM (for livestock protection), shooting, and use of dogs (decoy, bay, and trailing), aimed at removing mammalian predators causing the damage. Field staff provide technical assistance on non-lethal methods, which are generally implemented by the producer.

2.6.8 How Does WS-Colorado Use Predator Damage Management to Protect Aircraft and Air Passengers from Wildlife Hazards?

Upon receiving a request for assistance from an airport authority, WS-Colorado can provide a variety of services, including assessing the situation, developing an operational plan, and assisting with implementing the plan. WS-Colorado may identify hazards to aircraft operations due to problematic birds or mammals, including predators. The operational plan generally includes recommendations for resolving wildlife hazards from all of these species. However, avian hazards to aviation are outside the scope of this EA, and are covered by the Colorado Bird Damage Management EA (WS 2013a). This EA covers WS-Colorado activities at airports which are designed to alleviate threats caused by mammalian predators (*i.e.*, PDM).

Direct operational activities consist of various harassment, live-capture, and lethal removal techniques aimed at removing mammalian predators causing hazards. Most PDM methods in Appendix A are used or recommended by WS-Colorado at airports, with the exception of aerial PDM, which would produce a safety hazard.

WS-Colorado personnel also provide ongoing technical advice to airport managers regarding methodologies to reduce the presence of wildlife in areas of operations within airports, including providing technical advice on various habitat management projects that could be implemented by airport personnel. In addition, WS-Colorado promotes improved wildlife strike recordkeeping, provides wildlife identification services (such as collecting evidence such as feathers or fur, which may be all that is remaining after a strike), and monitors animal numbers at participating airports to assist in developing and refining effective WDM programs.

2.6.9 How Does WS-Colorado Use Predator Damage Management to Protect Natural Resources?

Under Alternative 1, WS-Colorado might conduct PDM to protect natural resources, including T&E species, at the request of land management agencies (BLM or USFS) or wildlife management agencies (USFWS or CPW). PDM for the protection of natural resources was discussed in Section 1.17.5. PDM to protect natural resources might include the following past, present, and future projects discussed below. Such efforts would not be limited to these projects; WS-Colorado would respond to all requests for PDM to protect natural resources by providing technical assistance and/or direct control, as deemed appropriate, effective, and legal.

2.6.9.1 Protection of piping plovers:

In the past, WS-Colorado has been asked for assistance with protecting federally endangered piping plovers from predation. Similar work might be requested in the future.

2.6.9.2 Protection of sage-grouse:

In the past, WS-Colorado has been asked for assistance with protecting federally threatened Gunnison sage-grouse from predation. Similar work might be requested in the future.

2.6.9.3 Protection of black-footed ferrets:

In the past, WS-Colorado has been asked for assistance with protecting federally endangered black-footed ferrets from predation in reintroduction areas. Similar work might be requested in the future.

2.6.9.4 Protection of mule deer:

WS-Colorado has been requested by CPW to reduce predation on several ungulate species over the years. Currently, the most likely requests would be to protect mule deer (*Odocoileus hemionus*), if predation was determined to be limiting population maintenance or growth. WS-

Colorado may also conduct PDM for research projects to assess the effect of predator control on mule deer or other ungulates. Two examples of such research are described below. CPW has asked WS-Colorado for assistance with predator control for the Piceance Basin research (Appendix G), and might ask for WS-Colorado assistance in the future for the cougar predation research (Appendix H).

Mule Deer Survival in the Piceance Basin of Colorado: CPW is currently conducting a study on the effect of predator control on mule deer populations in the Piceance Basin of northwest Colorado. This basin is the winter range of the largest migratory mule deer population in Colorado. This area has been the focus of research and monitoring efforts since the late 1940's, and likely represents one of the best documented mule deer populations in North America. Research efforts conducted during the 1980s (Bartmann *et al.* 1992) documented a high density deer population (mean winter density = 63/km^2) which appeared to be at or near carrying capacity. During the early 1990s, this population declined to about 1/3 of the previous winter range density (mean winter density = 23/km^2; White and Bartmann 1998), likely due to exceeding the forage capacity on winter range.

Thirteen years later (January 2008), another research effort was initiated to address mule deer/energy development interactions in the Piceance Basin (Anderson 2015; Federal Aid Project No. W-185-R), where similar data were collected to provide comparisons to mule deer demographic data from the 1980s and early 1990s. In comparing data between the 2 time periods (1982-1990 before the decline and 2008-present from unmanipulated control areas), they found evidence that mule deer in the Piceance Basin are no longer limited by habitat conditions:

(1) December fawn weights have increased (averaging 3.7 kg heavier),

(2) over-winter fawn survival (Dec – June) has more than doubled (averaging 0.737 versus 0.351), and

(3) winter starvation has become rare (<3% of collared fawns), which was common during the 1980s (averaging 33% annually).

Further evidence that this population is no longer limited by forage conditions was provided by Monteith *et al.* (2014), who found that the population was below the animal-indicated "nutritional carrying capacity" based on doe body condition measurements.

Whereas habitat no longer appears to be the limiting factor, annual winter fawn recruitment has declined from ~73 fawns/100 does to ~49 fawns/100 does, and the average mule deer densities since 2008 (mean late winter density = 19.1/km^2) are comparable to the relatively low levels observed during 1994 and 1995 (mean mid-winter density = 23.5/km^2; White and Bartmann 1998). Because over-winter fawn survival is high, but early winter fawn recruitment appears low, there is need to discern why fewer fawns appear to be arriving on winter range in the Piceance Basin. Data collected during the ongoing research largely rules out issues surrounding low fecundity; pregnancy and twinning rates have been consistently high, averaging 95% since 2009 and 1.75 in utero fawns/doe. Thus, evidence suggests that more information is needed in order to better understand early fawn survival, from birth until December.

Newborn fawn survival has been addressed in the Piceance Basin the past 4 years (in partial collaboration with Colorado State University). Thus far, neonate survival has been relatively low (~40%) with a large portion of mortality attributed to predation (at least 49% of collared fawns), and low frequency of malnutrition (<4%). This suggests that predation may be limiting neonatal (*i.e.*, 0–6 months old, June – December) survival and recruitment to winter range if predation is additive to other types of mortality (*e.g.*, disease, starvation). Monteith *et al.* (2014) reported high predation rates of mule deer neonates in California (>60% bear predation) and documented that predation, rather than nutrition, was limiting the population.

Past research evaluating success of predator reduction to enhance ungulate populations has provided mixed results. Hurley *et al.* (2011) addressed coyote (*Canis latrans*) and cougar (*Puma concolor*) reduction to enhance mule deer populations in Idaho. They reported that coyote predation of mule deer was related to lagomorph abundance, and that coyote control exhibited no influence on early winter fawn recruitment. They also found that cougar reduction resulted in increased survival and winter fawn recruitment, but was largely ineffective when environmental factors (*e.g.*, drought, severe winters) limited mule deer populations. Keech *et al.* (2011) addressed wolf (*C. lupus*) and bear (*Ursus* spp.) predation on moose (*Alces alces*) in Alaska and noted that predator reduction enhanced moose populations when environmental factors were non-limiting (*i.e.*, during summer and fall). Predator reduction may benefit prey populations when they are not limited by habitat/environmental conditions, when predation is identified as a limiting factor, and when predator reduction is focused in scale to effectively reduce predation rates and timed to address critical periods in prey survival (Mule Deer Working Group 2013). Rayl *et al.* (2015) determined predator reduction (bears) would be effective if conducted while caribou are calving, and over a larger area than the calving grounds, because bears travel to known resources.

To address the reason for declining winter fawn recruitment in the Piceance Basin and identify potential management options, CPW proposes to continue monitoring newborn fawn survival for another 3 years, while simultaneously implementing short-term and focused predator control in a treatment area and comparing fawn survival to an unmanipulated control area. This information will provide evidence to determine if predation is additive or compensatory to other types of mortality (*e.g.*, disease, starvation). If neonate predation is additive to other forms of mortality, focused predator reduction during mule deer parturition might be useful to enhance neonate survival and recruitment in mule deer populations experiencing population declines not limited by environmental conditions. If, on the other hand, neonate predation is compensatory, predator management would not be a useful management too, because it would not affect the mule deer population. Conditions in the Piceance Basin are comparable to other western Colorado mule deer populations, where high winter fawn survival and low starvation frequency has been documented. As such, the information from the Piceance Basin study will likely be applicable to declining or below-objective deer herds in much of the western third of the state exhibiting factors inconsistent with climate or habitat limitations (*e.g.*, low starvation frequency, good forage conditions).

When mortality to a population is evaluated to determine if the population is declining due to nutrition, predation or weather events, the importance of compensatory mortality versus additive mortality is paramount (Ballard *et al.* 2001, Bergman *et al.* 2015). The cause of death is less important because in a population at carrying capacity the number of individuals exceeding the habitats threshold to support them will have died of various causes (Bartmann *et al.* 1992, Ballard *et al.* 2001, Bishop *et al.* 2009, Bergman *et al.* 2015). It is also possible to have a population response showing mortality is partially compensatory or partially additive depending on the prey population's relationship with the habitat carrying capacity (Bergman *et al.* 2015). Discerning if the cause of mortality is proximate (immediate) cause or ultimate cause can have importance to avoid incorrect conclusions about mule deer population dynamics (Ballard *et al.* 2001, Forrester and Wittmer (2013). Bartmann *et al.* (1992), Bishop *et al.* (2009) and Bergman *et al.* (2015) showed while coyote predation was a major cause and the proximate cause of most mule deer fawn predation in Colorado, the reduction in coyote population only resulted in the increase in mule deer fawn malnourishment deaths in two study areas and no increase in the mule deer population. In these two cases, compensatory mortality drove the outcome and the ultimate cause of death was nutritional or habitat carrying capacity.

The vulnerability of individual mule deer or prey to predation from coyotes, mountain lions and other predators will vary (Bishop *et al.* 2009). The variation can be due to age (young or old), solitary versus in a group, malnourished or healthy, physical condition, disease, habitat type, landscape features, weather conditions or other factors (Whittaker and Lindzey 1999, Ballard *et al.* 2001, Anderson and Lindzey 2003, Bishop *et al.* 2009, Forrester and Wittmer 2013, Bergman *et al.* 2015). The role of disease appears minor in most mule deer populations but has affected some local mule deer populations (Forrester and Wittmer 2013). Krumm *et al.* (2010) and Miller *et al.* (2008) reported mountain lions selecting mule deer with chronic wasting disease proportionally more than mule deer without disease. Mountain lion predation does not appear to control prion transmission for chronic wasting disease (Miller *et al.* 2008). How an animal dies is inconsequential and irrelevant when managing a prey population since all animals above habitat carrying capacity will die from some form of compensatory mortality (Bergman *et al.* 2015). Vulnerability can play a role when predation is additive and vital rates for key age and gender classes (*e.g.*, adult female, neonate fawns) are disproportionately affected destabilizing the mule deer population (Forrester and Wittmer 2013).

<u>Mule deer survival and effects of cougar predation on a central Colorado population</u>: The recently adopted Colorado mule deer strategy identifies predation as one of the potential factors limiting Colorado mule deer populations (CPW 2014a, Ballard *et al.* 2001). Since the adoption of the mule deer strategy by the Parks and Wildlife Commission, members of the CPW Leadership Team developed a plan for the implementation of the strategy. As part of the implementation strategy, CPW staff examined existing predator and deer research, and monitoring data, in order to identify areas where predation might be limiting mule deer populations, which in turn could be used to inform predator harvest/management decisions. In June 2015, CPW personnel from the SE Region, Terrestrial, and Research branches met to explore the concept for a project that examines how deer demographic parameters may change following cougar suppression.

From 1999-2014, averaging across all years, the leading known cause of both doe (6.4%) and fawn (7.5%) mortality has been cougar predation (Anderson 2015). Cougar predation has ranged from 0 to 60% (avg. 28%) of the total mortality for does and 0 to 64% (avg. 32%) of the total mortality for fawns. Currently, the mule deer population in deer management area D-16 (11,247) is below the long-term population objective of 16,000-20,000 deer. Based on survival data from 1999-2014, deer population growth in D-16 might be at least partially limited by cougar predation on fawns and adult does (Anderson 2015).

Overwinter fawn survival has shown similar patterns to annual doe survival ranging between 59.2% and 86.2%. Since 2013, overwinter fawn survival has been near 80% (Anderson 2015). However, early winter fawn-to-doe ratios in D-16 have averaged 54.7 fawns per 100 does (range 38.5 to 68.0) since 1995 (CPW, unpublished data). Assuming fetal rates for adult (≥ 2 years old) mule deer of 1.8 (Bishop *et al.* 2008), it would appear neonate survival is a bigger issue for population growth and recruitment than other demographic rates, unless doe survival drops below 80%.

The success of a project to control predators to increase a population of mule deer is dependent upon the deer population in relation to the biological carrying capacity (Ballard *et al.* 2001). If the population is at or above the carrying capacity, it is likely that any increases in survival rates caused by predator control will be compensated for by other factors of mortality, such as malnutrition (*i.e.*, predation mortality is compensatory; Bartmann *et al.* 1992). Conversely, if the population is below the carrying capacity, reduction in mortality caused by predation could provide an additive response to increase survival rates of a mule deer population (*i.e.*, predation mortality is additive; Bleich and Taylor 1998; Hurley *et al.* 2011). Where predation mortality is compensatory, predator control would not be expected to affect prey populations. Where predation mortality is additive, predator control would be expected to increase prey populations.

Examination of the malnutrition rates of fawns can give some indication about whether a population is above or below carrying capacity. Since 1999, the highest rate of malnutrition was observed in 2004, when 5 of 57 (9%) fawns died from malnutrition causes. Bartmann *et al.* (1992) observed significantly higher rates of malnutrition in a NW Colorado mule deer herd, in which they documented reductions in predation rates being compensated by higher rates of malnutrition. The relatively low rates of malnutrition (1.6%) observed since 1999 suggests that the current population in D-19 is below carrying capacity, and limiting factors such as predation, may be restricting mule deer population growth (Anderson 2015).

In order to assess the effect of management manipulations, it is necessary to do this in an experimental framework with a control and treatment study area, otherwise the magnitude of the effect will be unknown as other limiting factors fluctuate. D-34 is an adjacent mule deer DAU to the south of D-16, which has a similar mule deer population size (10,468) and habitat. Surveys (winter flights) also suggest that demographic rates are similar in terms of population ratios (45.2 fawns per 100 does based on 5 year average). Using D-16 and D-34 in a crossover design will allow for the manipulation of a potential limiting factor for mule deer population growth or survival, and examination of similarities in the response as the control and treatment is switched between the areas.

A CPW research project is being conducted in these DAUs to examine the mule deer population response to cougar suppression, which will include three stages. In stage one (years 1-3), cougar populations in D-16 will be suppressed (50% of population potential), while cougar populations in D-34 will be allowed to increase towards habitat potential with light harvest (10% harvest). Stage 2 (years 4-6) will be a recovery stage where both populations will be allowed to increase towards habitat potential (10% harvest). The final stage (years 7-9) will complete the crossover; D-34 cougar populations will be suppressed (50% of population potential), while D-16 will continue to be allowed to increase towards habitat potential with light harvest (10% harvest).

The impact of cougar hunting on cougar populations, especially high levels designed to suppress populations, can be varied and is not well understood. Anderson and Lindzey (2005) demonstrated that a Wyoming cougar population could be significantly suppressed through 2 years of heavy harvest. Harvest rates of approximately 15% of the population have generally been shown as the tipping point between maintaining stable populations and decreasing populations. However, the percent adult female harvest is the crucial factor in population change.

The direct effect of harvest on population size is fairly clear but more subtle impacts on other demographic parameters is less clear, primarily due to a lack of information on these parameters. Cougars are inherently difficult to study because of their reclusive nature, small population sizes and large movement patterns. Technological advances, such as GPS collars, are now allowing for the detailed study of cougars to understand these more subtle impacts.

Past research has been limited by small sample sizes and case studies of a few events observed during the course of monitoring studies.

Harvest structure can be a useful tool for monitoring and managing cougar populations (Anderson and Lindzey 2005). Because the sex and age classes of cougars exhibit different behaviors and movement patterns (Barnhurst 1986) they also tend to differ in their vulnerability to harvest. The management experiment being conducted provides a unique opportunity to better understand the relationship between harvest structure and cougar population structure. Understanding this relationship as populations are manipulated throughout the management experiment will provide critical information for management in the future, as decisions are made about managing cougar populations.

This management experiment will also provide information on population level responses to various harvest strategies. Several studies have examined the impacts of harvest on cougar populations (Anderson and Lindzey 2005, Cooley *et al.* 2009, Ruth *et al.* 2011, Wielgus *et al.* 2013, Maletzke *et al.* 2014, Logan 2015), however none have examined the impact of hunting at these two ranges in harvest level within a controlled crossover design.

One aspect of this study will be to closely examine cause-specific mortality and develop a thorough understanding of levels of mortality in relation to population size and hunting pressure. Previous studies have suggested that male survival is lower in hunted populations (Lambert el al. 2006, Robinson *et al.* 2008, Ruth *et al.* 2011) but that female survival is lower in non-hunted populations (Logan and Sweanor 2001). Part of this is due to hunter selectivity on males. However, under situations of heavy harvest, selectivity may decrease (Anderson and Lindzey 2005). The progression of the management experiment will directly allow CPW to measure cause-specific survival during declining and increasing phases of a cougar population and under heavy and light harvest scenarios. This will allow a clear examination of non-hunting mortality rates, such as disease, intra-specific strife, or other natural mortality.

Similarly, cause-specific kitten mortality will provide essential information for management, because this directly relates to population growth and recovery. Past research has suggested that increased harvest has actually led to decreased kitten survival due to infanticide (Cooley *et al.* 2009, Ruth *et al.* 2011). Increased infanticide has been suggested to relate to high male harvest, resulting in territorial instability (Logan and Sweanor 2010, Ruth *et al.* 2011). However, recent cougar research in Colorado has shown higher infanticide rates during a 5 year non-hunting period than the subsequent 5 year hunting phase of the study (Logan 2015).

Other aspects of cougar population growth are reproductive rates and immigration/emigration rates. Theory behind density-dependent relationships suggests that reproductive rates increase with increased harvest. Increased male immigration has been documented as a result of increased harvest levels (Cooley *et al.* 2009, Wielgus *et al.* 2013). Almost all males disperse, regardless of cougar density, with typical dispersal distances of 85 to 100 km (Sweanor *et al.* 2000). However, 50 to 80% of females remain in their natal range, establishing overlapping home-ranges with other breeding females (Sweanor *et al.* 2000). In a recent cougar study on the Front-Range of Colorado, a significant portion of subadult males did not disperse (M. Alldredge, CPW, unpublished data). It is unclear how various levels of harvest will impact immigration/emigration rates, and the potential impact that this could have on reproductive rates. Wielgus *et al.* (2013) suggest that increased immigration actually decreased female reproductive success.

There is also the perception that high immigration rates of subadult males will lead to increases in human conflict and livestock depredation. Some studies have indicated that harvest and subsequent increases in subadult males have correlated with human-cougar conflict (Peebles *et al.* 2013, Maletzke *et al.* 2014). However, Kertson *et al.* (2013), suggest that demographic class did not relate to human-cougar interaction. The CPW management experiment will provide direct information on human-cougar interactions with respect to changes in cougar populations, age structure, and immigration rates.

Cougar hunting has also been linked to changes in movement patterns, home-range size, and diet composition. Keehner *et al.* (2015) suggested that female cougars will switch primary prey in an attempt to avoid conflict with male cougars in a hunted population. Increased hunting pressure was also suggested to increase home-range size and overlap in Washington (Maletzke *et al.* 2014) suggesting increased intraspecific conflict. Avoidance behaviors, increased space use, and changes in movement patterns could all impact energetic demands of cougars, which could then alter foraging behavior.

Estimating cougar population size or density is also very useful for management purposes but has proven to be difficult and expensive. Historically mark-recapture techniques have been used, which require the physical capture and handling of animals and is therefore expensive. More recently developments have been made for noninvasive genetic sampling of cougars to estimate populations using scat detection dogs or hair snags. The hair snag approach and it is showing promising results in Colorado (M. Alldredge, CPW, unpublished data). In a hunting situation, especially when reporting is mandatory, harvest data can be used to supplement these data in statistical population reconstruction models (Fieberg *et al.* 2010, Skalski *et al.* 2012, Gast *et al.* 2013). Throughout the CPW management experiment, both hair snag and harvest data will be available to test these procedures, and develop techniques to obtain better population densities statewide. GPS collared cougars will provide baseline data for assessing potential bias in estimates.

2.6.9.5 Protection of Pronghorn (*Antilocapra americana*) and Bighorn Sheep (*Ovis canadensis*).

Under some circumstances, PDM can be an important tool in attaining specific wildlife management objectives, especially when predation has been identified as a limiting factor, and when populations are below management objectives or carrying capacity. The use of PDM activities to protect big game species in Colorado is a decision which rests with CPW; WS-Colorado may assist CPW at their request. In such cases, WS-Colorado will use those PDM strategies which would likely be effective and successful (Ballard *et al.* 2001). However, as the management agency, CPW would determine when and where PDM would be conducted. WS-Colorado has not been asked by CPW to protect pronghorn or bighorn sheep populations from predation. However, if predation were to be identified as a limiting factor, or if CPW were to study these effects, CPW might request WS-Colorado assistance in the future. WS-Colorado would provide assistance with PDM in these situations whenever WS-Colorado determined it to be warranted and effective.

2.6.9.6 Nesting Upland Gamebirds, Waterfowl, and Shorebirds

WS-Colorado has received few requests from CPW or other agencies in recent years to provide protection for nesting upland gamebirds, waterfowl, or shorebirds from predators, most recently in FY12 to protect threatened piping plovers from coyote predation. (WS-Colorado has also conducted PDM to protect Gunnison's sage-grouse from predation by coyotes and common raven, but this work is discussed separately because these birds are federally threatened). APHIS-WS also conducts PDM projects in several other parts of the U.S. to protect nesting birds that are federally listed T&E species, and similar assistance might be requested of the WS-Colorado program in the future. For example, APHIS-WS conducted PDM for Attwater's greater prairie-chickens in Texas (USFWS 1998) where predation by skunks, coyotes, and other species was identified as a limiting factor in their recovery. Avian species that are federally listed in Colorado and that could be impacted by predators include: the least tern (endangered) and the Gunnison's sage-grouse (threatened). Additional support may be given to these species should it be determined by an agency with management authority over such species that predation from predators has limited their viability. PDM projects to protect nesting birds are typically of short duration and limited to just prior to and during the critical nesting periods when the eggs, chicks, and setting birds are most vulnerable. PDM activities for nesting birds are typically focused on a few species of mammalian predators known for depredating nests of eggs, incubating females, and nestlings from raccoons, skunks, red foxes, and coyotes.

2.6.10 How Does WS-Colorado Use Predator Damage Management to Protect Human and Pet Health and Safety?

Upon receiving a request from a state or local government agency to alleviate a human-bear, -mountain lion, or -coyote conflict, WS-Colorado uses the WS Decision Model to determine the best course of action. If operational assistance is warranted, WS-Colorado develops an operational plan, and implements the plan. WS-Colorado has standing agreements with state agencies to provide these services. This includes various non-lethal and lethal methods described in Appendix A. Operational programs to protect human safety would include various live-capture and lethal removal techniques, including shooting, and use of dogs (decoy, bay, and trailing), aimed at removing mammalian predators causing the threat. Field staff provide technical assistance on non-lethal methods, which are generally implemented by the requester. A similar process would be used to respond to requests to protect pets from predation.

2.6.11 What Other Entities Conduct PDM in the Absence of WS-Colorado Action and Why Are Their Actions Included in These Analyses?

Worldwide, humans have been removing large carnivorous predators for millennia, resulting in complete eradication or severe range reductions. This direct control may occur for many reasons, including fear, active threats to health and safety, and competition for food, land, or resources of human value, while indirect control may occur through habitat and ecosystem losses and fragmentation, climate change, accelerating resource extraction, and poverty (for example, Sacks *et al.* 1999a, Prugh *et al.* 2009, McShane *et al.* 2011). These chronic conflicts with humans and human activity often result in direct take of large carnivores by someone or some organization.

Currently, WS-Colorado takes several species of predators (see Section 3.1) which damage or threaten human property or safety, and natural resources. In the absence of WS-Colorado conducting these PDM actions, the amount of damage would likely increase (see Section 3.2 and 3.3), and it is likely that other agencies, groups, or individuals would continue to take predators in an effort to alleviate the damage. WS-Colorado's PDM activities do not exist in a vacuum, and it is logical to consider the likely unintended consequences of both our actions and our inactions. In fact, CEQ, the agency responsible for implementing NEPA, has directed Federal Agencies to do just that. According to CEQ regulations, the "human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment" (40 CFR §1508.14). Further, in their "Forty Most Asked Questions" CEQ (1981) states:

> *"Where a choice of 'no action' by the agency would result in predictable actions by others, this consequence of the 'no action' alternative should be included in the analysis."*

Therefore, WS-Colorado will analyze not only the effects of its actions, but also the potential impacts that would occur when another entity takes the same or similar action in the absence of the APHIS-WS action.

One example of such an impact occurred in Marin County, California, when WS-California ended their PDM program in the County. Under the county-managed cost-share program that replaced WS-California activities, individual producers and others working on their behalf now routinely practice snaring, calling and shooting, and denning in an effort to kill damage-causing coyotes, most intensely in winter and spring. When "hot spots" occur with multiple losses on adjacent ranches, ranchers collaborate on hunting parties in an effort to eliminate the depredating coyote(s). It is likely that some ranchers themselves are taking more coyotes than when APHIS-WS activities were taking place. There are no data on current take of target or non-target species by landowners or their agents (Larson 2006).

State agencies also have legal authority to respond to and manage wildlife conflicts. As discussed in Chapter 1, CPW and CDA have legal wildlife damage management authority, and these agencies issue depredation permits and permits for aerial PDM, respectively. For many predators not managed as game or furbearer mammals in Colorado, property owners can also remove such animals causing depredation or damage with a permit issued by CPW or without a permit, depending on the species. In addition, CPW can set take limits for game and furbearer predators during hunting and trapping seasons in order to manage population levels to meet state objectives.

Private and commercial property owners can also request assistance from pest control companies to provide PDM services, or authorize another person(s) to remove damaging species. Per Colorado statutes [CRS § 33-6-107(9)], landowners or their agents may take certain animals (not otherwise restricted by federal or state law) causing damage, nuisance, or concerns with human health or safety. However, for most species a permit to remove the animal is needed. No permit is required for a landowner to take depredating or threatening coyote, raccoon, bobcat, red fox, or badger. Coyotes and red foxes may be taken by aerial PDM on private land with a permit from CDA and permission from the landowner.

Federal, State, commercial, and private entities receive authorization to conduct PDM from the CPW and CDA, and most methods for resolving predator damage are available to both WS-Colorado and to non-federal entities (except for M-44s, Large Gas Cartridges, and certain other methods on public lands; Table 2-4). Under all alternatives, including those in which WS-Colorado would not conduct direct lethal PDM, other entities will be conducting PDM.

All non-lethal methods and most lethal methods are available to non-WS-Colorado entities. Only WS-Colorado has authority to use M-44s in Colorado per the FIFRA label. M-44s are used very infrequently by WS-Colorado staff. WS-Colorado generally uses M-44s in situations where coyotes have proven difficult to remove using other methods.

2.7 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

This alternative is similar to Alternative 1 (Proposed Action/No Action), in that WS-Colorado would provide technical assistance, including both non-lethal and lethal recommendations, advice, and information for others to implement. Under this alternative, WS-Colorado would recommend lethal and non-lethal methods, including all methods discussed in Section 2.6 and Appendix A. WS-Colorado would also provide direct operational assistance to implement non-lethal and lethal PDM activities.

This alternative differs from Alternative 1 in that WS-Colorado field personnel would not directly provide any lethal operational assistance for preventive control, even if contracted as an agent of CPW. WS-

Colorado might recommend preventive lethal PDM, but cooperators would be dependent on contracting assistance from commercial companies, pilots with state aerial depredation permits, or CPW or their agents for their lethal PDM responses, or conduct the actions themselves, as allowed by state law.

WS-Colorado conducts preventive PDM only for coyotes. In most cases, predator damage cannot be predicted, so preventive lethal PDM would not be effective. However, coyote depredation on lambs and calves is predictable during lambing or calving season, and preventive lethal PDM during winter or early spring can prevent damage. This is most often conducted by aerial PDM because it is the most cost-effective method. Under Alternative 2, these activities would not be conducted by WS-Colorado. Private individuals can obtain permits from CDA to perform these activities.

WS-Colorado would have no responsibility for any lethal and non-lethal actions implemented by requester upon advice and recommendations from agency personnel. The requester is responsible for compliance with the Endangered Species Act and all other federal, state, and local laws and regulations.

2.8 Alternative 3 – WS-Colorado Provides Technical Assistance Only.

Under Alternative 3, WS-Colorado would provide both non-lethal and lethal technical assistance, similar to Alternatives 1 and 2. However, WS-Colorado would provide no operational assistance, including non-lethal and lethal methods. All operational PDM in Colorado would be conducted by state or local governmental agencies, other federal agencies, or private entities. This would effectively preclude the use of certain methods, such as M-44s, because they are approved only for use by APHIS-WS. It would also limit the use of other methods such as aerial PDM, foot-hold traps, snares, thermal imaging, night vision, and dogs, depending on the type of land (see Table 2-4).

Non-lethal and lethal technical assistance would continue to be provided to cooperators and requesters as described in Alternative 1. Non-lethal technical assistance includes collecting information about the species involved, the nature and extent of the damage, and previous methods that the cooperator had used to alleviate the problem. WS-Colorado would then provide the cooperator with information on appropriate non-lethal and lethal to alleviate the damage themselves. Types of technical and direct non-lethal assistance projects may include a visit to the affected property, written communication, telephone conversations, or presentations to groups such as homeowner associations or civic leagues.

In some cases, WS-Colorado may provide supplies or materials for non-lethal methods that are of limited availability for use by private entities, such as loaning propane cannons. Generally, WS-Colorado could describe several non-lethal management strategies to the requester for short- and long-term solutions to managing damage, as well as recommend and provide training on lethal techniques. Those persons receiving technical assistance from WS-Colorado could implement those recommended methods, could use other lethal and non-lethal methods not recommended by WS-Colorado, could seek assistance from other entities, or take no further action. WS would only loan equipment or implement those non-lethal methods legally available for use by the requester, and advise them of any permits needed.

For non-lethal methods, this Alternative would not be substantially different from Alternative 1, because most non-lethal methods are implemented by the cooperator, as discussed earlier. The major difference under Alternative 3 is that WS-Colorado would not conduct operational lethal PDM. Many cooperators rely on these services from WS-Colorado because they lack the technical expertise to implement them on their own, or it is more cost-effective to pay for these services from WS-Colorado. Under Alternative 3, cooperators would need to conduct these methods on their own, or hire other entities or individuals to conduct these methods. This would limit the methods available for use as discussed in this Section above.

WS-Colorado would have no responsibility for any lethal and non-lethal actions implemented by requester upon advice and recommendations from agency personnel. The requester is responsible for compliance with the Endangered Species Act and all other federal, state, and local laws and regulations.

2.9 Alternative 4 – No WS-Colorado PDM Program.

Under this Alternative, WS-Colorado would not be involved in any PDM efforts in Colorado. PDM would still be implemented by other legally-authorized entities, such as CPW, USFWS, property owners, commercial PDM companies, certified CPW volunteers, and private individuals. Entities experiencing damage caused by predators could continue to resolve damage by employing all methods legally available, since the removal of predators to alleviate damage or threats would occur despite the lack of involvement by WS-Colorado.

WS-Colorado would not provide assistance with any aspect of managing damage caused by predators in Colorado, including lethal and non-lethal technical or operational assistance and actions. Requesters would need to seek PDM information on existing and new methods (including methods developed and tested by the APHIS-WS NWRC) from other sources such as CPW, University of Colorado Extension Service offices, or pest control companies. Currently, CPW only provides direct WDM assistance in limited situations, but does provide technical assistance and issues depredation permits for such activities as appropriate and within available resources. Requests for PDM information directed to WS-Colorado would be redirected to these entities.

2.10 What Alternatives Are Not Considered in Detail?

Several alternatives have been considered by WS-Colorado, and determined not to warrant detailed analysis. Other alternatives have been requested by commenters responding to previous APHIS-WS PDM EAs. These have been considered by WS-Colorado, and those in this section have been determined not to warrant further detailed analysis.

The CEQ regulations at 40 CFR §1508.14 state that agencies "shall rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated."

By definition, a "*reasonable*" alternative must be one that meets the underlying need for action or goal:

- "*proposal exists at that stage in the development of an action when an agency…has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal*…" (40 CFR §1508.23).
- "*The statement shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action*." (40 CFR §1502.13)

Guidance in the CEQs "40 Most Asked Questions" (CEQ 1981) states that reasonable alternatives must emphasize what the agency determines "*is 'reasonable' rather than on whether the proponent or applicant likes…a particular alternative. Reasonable alternatives include those that are practical or feasible from the technical or economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant*."

Consistent with NEPA regulations and CEQ guidance, WS-Colorado reviewed alternatives and ideas considered by WS-Colorado and proposed by commenters. In this section, we identify and briefly describe those that are determined by the agency as not reasonable per the CEQ criteria, and provide the agency's rationale for not considering them in detail in this EA.

2.10.1 Livestock losses should be an accepted cost of doing business (a threshold should be reached before providing PDM service).

Some persons feel that livestock producers should expect some level of loss as a cost of doing business, and that WS should not initiate any management actions until economic losses reach some predetermined "threshold" level. Although some losses of livestock and poultry can be expected and tolerated by livestock producers, WS has a legal responsibility to respond to requests for WDM, and it is program policy to aid each requester to minimize losses. If damage management efforts are not initiated soon after a damage problem is detected, damage might escalate to excessive levels before the problem is solved. WS uses the Decision Model (Slate *et al.* 1992) to determine appropriate strategy.

2.10.2 No PDM at taxpayer's expense (PDM should be fee based).

Some persons feel that WDM should not be provided at the expense of taxpayers or that it should be fee based. A common argument for public funded WDM is that the public should bear responsibility for damage to private property caused by pubic wildlife. WS was established by Congress as the agency responsible for providing WDM to the people of the United States. Funding for WS come from a variety of sources in addition to federal appropriations. Such nonfederal sources include State general appropriations, local government funds (county or city), livestock associations, Indian tribes, and private funds which are all applied toward program operations. Federal, state, and local officials have decided that PDM should be conducted by appropriating funds. Although not required by law, the WS-Colorado program currently requests cooperative local government or private funding to cover about 50% of the program's management services are, in essence, "fee based" to a relative high degree for a federal program. Additionally, WDM is an appropriate sphere of activity for government programs, since wildlife management is a government responsibility.

2.10.3 Use of Only Non-lethal Direct Assistance by WS-Colorado

Under such an alternative, WS-Colorado would still provide non-lethal and lethal technical assistance, but would not provide any lethal direct assistance. Requesters often apply their own non-lethal methods, whether recommended by WS-Colorado or implemented on their own, because it is generally logistically and economically more feasible. As such, this alternative would be nearly identical to Alternative 3: WS-Colorado provides technical assistance only. For an assessment of the "only non-lethal direct assistance by WS-Colorado", refer to the analyses of Alternative 3, which would be substantially similar.

This alternative will not be considered in detail because it is substantively similar to Alternative 3.

2.10.4 Use of Only Lethal Methods by WS-Colorado

Under this alternative, WS-Colorado would only provide technical and operational assistance using lethal PDM techniques. Prohibiting WS-Colorado from using or providing technical assistance on effective and practical non-lethal PDM alternatives is not effective, not ethically acceptable to wildlife professionals, and is contrary to agency policy and directives (WS Directive 2.101), in which APHIS-WS gives preference to the use of non-lethal methods before lethal methods when practical and effective.

In some situations, non-lethal methods can supplement, reduce, or eliminate the need for lethal control, and might provide a more effective short-term or long-term solution to PDM problems than lethal methods. For example, the use of guard dogs might be effective at reducing predation rates of livestock, or installing proper fencing when practical can protect resources and exclude some predators from areas. In other circumstances, lethal methods best and most effectively resolve the damage in a timely manner. Also, at times lethal methods might not be available for use due to safety concerns or local ordinances prohibiting the use of some lethal methods.

The option to consider both lethal and non-lethal methods as part of the APHIS-WS Decision Model (Section 2.6.2) allows WS-Colorado to use the most effective and practical methods available, while accounting for the many legal, logistical, biological, ethical, and environmental variables in each unique damage situation. Finally, most members of the public that comment on APHIS-WS NEPA documents feel strongly that there be more emphasis on using non-lethal methods to resolve damages, which is already APHIS-WS policy (WS Directive 2.101).

For these reasons, this alternative is not considered in detail.

2.10.5 Use of Only Non-lethal PDM Technical Assistance

WS-Colorado would provide only non-lethal technical assistance and non-lethal operational assistance. WS-Colorado would not implement nor advise others on the use of lethal methods.

Non-lethal technical assistance is included in Alternative 2, which is considered in detail in this EA (Section 2.7), as well as included in Alternatives 3 and 4 to a lesser degree. If the requester has taken all reasonable non-lethal actions and the problem still persists, it is not logical that the WS-Colorado specialist would not also provide professional advice regarding effective lethal methods that are legal for the requester to use in Colorado. Therefore, considering this alternative in detail would be redundant and would not be reasonable, logical, or professional.

Therefore, this alternative will not be considered in detail.

2.10.6 WS-Colorado Verifies that Reasonable Non-lethal Methods are Used Before Implementing or Recommending Lethal Operations

Under this Alternative, WS-Colorado would provide both non-lethal and lethal technical assistance, as well as both non-lethal and lethal operational assistance, similar to Alternative 1. However, reasonable non-lethal methods would have to be shown ineffective to resolve the damage or threat before WS-Colorado would take lethal action.

This alternative would preclude lethal preventive assistance conducted by WS-Colorado, because assistance would not be taken until WS-Colorado had confirmed and recorded that reasonable non-lethal actions had not resolved the problem, that the problem is ongoing, and that lethal methods would effectively address the depredation. Depredation from previous years or seasons would not be used as a reason for applying lethal management. The definition of "reasonable" would ostensibly be determined in the field by the WS-Colorado employee in coordination with the cooperator, and would include consideration of the specific circumstances, conditions (*e.g.*, weather, proximity to residences, access by the public), and costs. For example, building anti-predator fencing around a large pasture is most likely not "reasonable", but it might be reasonable around a smaller holding area. The implementation of this alternative would requires that:

- Livestock grazing permittees and operators, landowners, and resource managers show evidence of sustained and ongoing use of reasonable nonlethal techniques aimed at preventing or reducing predation prior to receiving WS-Colorado assistance with lethal PDM methods;
- Employees of WS-Colorado use or recommend appropriate and reasonable non-lethal techniques in response to a confirmed damage situation prior to using lethal methods; and
- Lethal techniques be used only when WS-Colorado had recorded and confirmed that the use of reasonable non-lethal techniques had failed to keep livestock or other losses below an acceptable level, as determined by the cooperator.

Cooperators would still have the option of implementing lethal control measures on their own or through commercial companies. WS-Colorado would continue to recommend lethal and non-lethal management when and where appropriate as technical assistance.

Per APHIS-WS Directive 2.101, preference is given to the use of non-lethal methods over lethal methods when appropriate and effective. It is not necessary that all possible non-lethal methods be used before lethal operations can be implemented; only that the requester have implemented and tested reasonable non-lethal methods under the circumstances.

This alternative would be very similar in effect to Alternative 2, because it would preclude the use of preventive lethal PDM. WS-Colorado already uses and recommends all "reasonable" non-lethal methods before using or recommending lethal methods, so this aspect would not be significantly different from Alternative 1 or 2. In addition, most agricultural producers already use non-lethal methods, and if these methods were determined to be "reasonable", this alternative would not differ from Alternative 1 or 2, except for non-agricultural situations, such as human health and safety, and protection of natural resources.

This alternative would differ from Alternative 2 in that it would require additional WS-Colorado resources in order to verify the application of "reasonable" non-lethal methods in many cases. These additional resources would need to be paid for; however, there is no congressional funding for such activities, and cooperators would be unlikely to pay for such costs.

For these reasons, this alternative will not be considered in detail. For an analysis of the potential impacts under such an alternative, see Alternative 2, which would produce similar results, except for the inability to fund the extra work by WS-Colorado employees.

2.10.7 WS-Colorado Verifies that All Possible Non-lethal Methods are Exhausted Before Implementing Lethal Operations

This alternative is similar to Alternative 3. However, in Alternative 3, only reasonable non-lethal methods applicable to the circumstances must be used and shown not to be effective in all cases. This alternative has been requested by various commenters, and requires that <u>all</u> non-lethal methods be used before any lethal operations can be implemented, including non-lethal methods that are not appropriate for the circumstances. This would result in the loss of substantial time, resources, and money for both the requester and WS-Colorado in implementing and monitoring all these non-lethal methods, and potentially result in large financial losses for the requester and/or a high risk of human/pet health or safety risks, and/or major losses to ESA-listed species. Alternative 2 considered in detail (Section 2.7) provides a reasonable and viable approach for addressing the needs of requesters and concerns of commenters without incurring unreasonable and unacceptable risks and losses.

Therefore, this alternative will not be considered in detail.

2.10.8 Use a Bounty System for Reducing Animals Causing Damage

Bounty systems involve payment of funds (bounties) for killing animals considered "undesirable," and are usually proposed as a means of reducing or eliminating any species that causes damage to human-valued assets, especially predators.

The only state that has an active bounty on predators, in this case coyotes, is Utah, for an experimental program for protection of mule deer, based on legislation passed in 2012 (https://wildlife.utah.gov/hunting-in-utah/hunting-information/762; viewed 12/9/2016).

APHIS-WS has no authority to establish a bounty system for population control, suppression, or extirpation, which falls to the states. Over half the states have either outlawed bounties, repealed bounty laws, or have no statutory involvement in bounties (http://www.bornfreeusa.org/b4a2_bounty.php; last accessed 13 December 2017).

The circumstances surrounding the removal of animals using bounties are typically arbitrary and unregulated because it is difficult or impossible to ensure animals claimed for bounty are not taken from outside the area where damage is occurring, as most state or local level bounty legislation that exists is regional or state-wide. Bounties can become a costly endeavor, do not effectively provide relief, and might encourage fraudulent claims.

Therefore, this alternative will not be considered in detail.

2.10.9 Provide Compensation for Losses

Compensation for wildlife damage caused by black bears and mountain lions, and crop damage caused by ungulates, may be paid by CPW (CRS 33-3-104). APHIS-WS has no legal authority or jurisdiction to provide for financial compensation for losses. None of the predators included in this EA are covered by compensation allowances under the Agricultural Act of 2014 (a.k.a., the 2014 Farm Bill). Difficulties with compensation programs are discussed in Bulte and Rondeau (2005). This issue is better addressed through the political process at the county or state level.

Therefore, this alternative will not be considered in detail.

2.10.10 Livestock Producers Should Exceed a Threshold of Loss Before PDM Actions are Taken

As explained in Section 1.18.2, two independent government audits, one conducted at the request of Congress, the other conducted by USDA and based on complaints from the public and animal welfare groups, found that, despite cooperator implementation of non-lethal actions such as fencing and herding, a need exists for APHIS-WS' program of direct and sometimes lethal PDM activities. The appropriate level or threshold of tolerance before using non-lethal and lethal methods differs among cooperators, their economic circumstances, and the extent, type, duration, and chronic nature of damage situations. On public lands, a history of loss may be sufficient for determining that preventative work would be appropriate. On private land, the landowner/resource owner determines when the level of tolerance has been reached and may take any lethal and/or non-lethal action determined appropriate that is legal per state and federal law.

The number of variables involved in determining the point at which a private entity or a government wildlife agency, for example, requests assistance from APHIS-WS for PDM preclude the ability or requirement to set a pre-determined threshold before a need is determined to exist and lethal and/or non-lethal action is requested and taken. WS-Colorado is not responsible for or required to assess the economic value of a particular loss or threat of loss before taking a PDM action, and WS-Colorado policy is to respond regardless of the requester's threshold of loss.

Therefore, this alternative is not considered in detail.

2.10.11 Use Regulated Hunting and/or Trapping to Reduce Predator Damage

CPW can and has used regulated sport hunting and trapping by private individuals as an effective population management tool in areas where predators are causing damage and/or adversely affecting wildlife populations managed by CPW. State-sponsored sport hunting and trapping programs can be one of the most efficient and least expensive techniques for managing populations over broad areas, but not necessarily within localized problem spots.

This alternative is not generally effective for addressing localized predator damages and threats at the time the problem is occurring. Evidence exists that humans are not effective at ecologically replacing carnivore functions because: (1) human hunting is usually conducted in the fall and winter, whereas damage often occurs in the spring and early summer; (2) age and sex of animals targeted by hunters is typically different than those targeted by carnivores; and (3) roads and other infrastructure often important for effective human hunting is not needed for hunting by carnivores (Ray *et al.* 2005). In addition, regulated hunting and trapping is often not allowed in urban or suburban areas because of safety concerns and local ordinances (Timm and Baker 2007).

Because this alternative is not within the authority of APHIS-WS to implement, it will not be considered in detail.

2.10.12 Live-Trap and Translocate Individual Predators Causing Damage

Under this alternative, all requests for assistance would be addressed using live-capture methods or the recommendation of live-capture methods. Predators would be live-captured using immobilizing drugs, live-traps, cages, or nets. All predators live-captured through direct operational assistance by WS-Colorado would be translocated. In accordance with state law, translocation of bears, mountain lions, and other predators must be approved by CPW. Therefore, the translocation of these predators by WS-Colorado would only occur as directed by CPW and/or as authorized by state law.

A permit from CPW is required to translocate most wildlife species in Colorado. With the exception of black bears and mountain lions, CPW generally does not permit the translocation of most predators, due to the healthy size of the populations statewide, the high risk of moving the problem along with the animal, the risk of disease transmission, the risk that the animal will return to its original home range, and the risk that the translocated animal will die due to occupied territories or unfamiliarity with the new location. Many smaller predators causing conflict are relatively abundant, such as coyotes, skunks, and raccoons. Others are not native, such as feral cats, dogs, and ferrets.

Translocation is also discouraged by APHIS-WS policy (APHIS-WS Directive 2.501) because of concerns with spreading the damage problem to other areas, spreading disease, concern with the animal returning to the capture site, and concern that the animals may fail to survive in the new area.

WS-Colorado could be requested and authorized by CPW to translocate problem black bears or mountain lions, as a component of any alternative that includes an active WS-Colorado program; however, these actions would be infrequent.

Therefore, this alternative is not considered in detail.

2.10.13 Manage Predator Populations through the Use of Reproductive Inhibitors

Methods for reproductive control for wildlife include sterilization (permanent) or chemical contraception (reversible). Sterilization in the field can be accomplished through surgical sterilization (vasectomy, castration, and tubal ligation) and chemical sterilization. Contraception can be accomplished through: (1) hormone implantation (synthetic steroids such as progestins), (2) immunocontraception (contraceptive vaccines), and (3) oral contraception (progestin administered daily). Contraception requires that each individual animal receive either single, multiple, or even daily treatment to successfully prevent conception.

Research into the use of these techniques consists of laboratory/pen experimentation to determine and develop the sterilization or contraceptive material or procedure, field trials to develop the delivery system, and field experimentation to determine the effectiveness of the technique in achieving population reduction. Prior to implementation, chemical contraception products must be registered and approved by the appropriate federal and state regulatory agencies. Research into reproductive control technologies has been ongoing, and the approach will probably be considered in an increasing variety of wildlife management situations by wildlife management agencies.

Bromley and Gese (2001a,b) conducted studies to determine if surgically-sterilized coyotes would maintain territorially and pair bond behavior characteristics of intact coyotes, and if predation rates by sterilized coyote pairs would decrease. Their results suggested that behaviorally, sterile coyote pairs appeared to be no different than intact pairs except for predation rates on lambs. Reproductively intact coyote packs were 6 times more likely to prey on sheep than were sterilized packs (Bromley and Gese 2001b). They believed this occurred because sterile packs did not have to provision pups and food demands were lower. Therefore, sterilization could be an effective method to reduce lamb predation if enough alpha (breeding) pairs could be captured and sterilized. During Bromley and Gese studies (2001a,b), they captured as many coyotes as possible from all packs on their study area; they controlled coyote exploitation (mortality) on their study area, and survival rates for coyotes were similar to those reported for mostly unexploited coyote populations, unlike most other areas. However, the authors concluded that a more effective and economical method of sterilizing resident coyotes was needed to make this a practical management tool on a larger scale (Bromley and Gese 2001b).

Jaeger (2004), Mitchell *et al.* (2004), and Shivik (2006) also describe the problems with chemical or physical sterilants for alpha coyotes for reducing livestock depredation during the denning season. The primary problems involve identifying and capturing the alpha pair, which are very difficult to capture, rather than beta and transient animals, which do not perform the depredations within packs with stable social structures. Capturing and sterilizing all animals, hoping that the alpha individuals are included, is extremely expensive and time-consuming.

Currently, no reproductive inhibitors are available for use to manage most large mammal populations due to (Mitchell *et al.* 2004):

- The costs associated with live-capturing and performing physical sterilization procedures on large mammals;
- The need for at least one and possibly multiple captures of individual animals for application of chemical contraception;
- The lack of availability of chemical reproductive inhibitors for the management of most mammal populations;
- Lack of research on the environmental effects of chemical sterilants and chemical contraception;
- The level of unknowns and disagreements within the professional wildlife management community regarding practicality of use, effectiveness, and potential impacts;
- The considerable logistic, economic, safety, health, and socio-cultural limitations to the use of fertility control on free-ranging predators.

If a reproductive inhibitor becomes available to manage a large number of mammal populations and has proven effective in reducing localized predator populations, the use of the inhibitor could be evaluated under the proposed action as a method available that could be used in an integrated approach to managing damage. APHIS-WS will monitor for new developments and, where practical and appropriate, could incorporate reproductive control techniques into its program after necessary NEPA review is completed.

Consideration of the use of reproductive inhibition for PDM will also require an analysis of the potential for impacting the target predator populations at local and statewide levels. As noted in Chapter 1, the goal of PDM is to reduce damage, without impacting local populations in the long-term, and without impacting statewide predator populations. Because the effects of reproductive inhibition might last longer than the effects of the methods considered in this EA, further analysis would be required. If and when an effective and useful reproductive inhibitor becomes available, WS-Colorado will conduct this analysis.

However, at this point, WS-Colorado would neither use nor recommend the use of reproductive inhibitors to reduce or prevent reproduction in mammals responsible for causing damage. Use and effectiveness of reproductive control as a wildlife population management tool is limited by population dynamic characteristics, such as longevity, age at onset of reproduction, population size, and biological/cultural carrying capacity; habitat and environmental factors such as isolation of target population, cover types, and access to target individuals); socioeconomic; and other factors.

Therefore, this approach is not considered for further analysis in this EA.

2.10.14 Use Only Non-lead Ammunition

Effects on various resources from the use of lead ammunition are discussed in Sections 3.2 and 3.4 of the EA. APHIS-WS' use of lead ammunition is a small fraction of total lead contamination from many sources. WS-Colorado and many other state programs have investigated the availability of effective and accurate non-lead ammunition, and have found that such ammunition is not readily available for the wide variety of firearm types used in Colorado and elsewhere, in the appropriate calibers. It is also more expensive at this point.

WS-Colorado will follow Department of Interior USFWS policy for eliminating the use of lead ammunition for management and research activities on lands and waters within the National Wildlife Refuge System under their jurisdiction. This policy requires non-lead ammunition to be used by employees of the USFWS, USDA-APHIS, other federal agencies, state agencies, and universities or private contractors for study and research. It also requires the use of non-lead ammunition for the dispatch of feral or trespassing animals when authorized, and the dispatch of injured animals. It does not apply to public hunting on refuges or taking of free-ranging animals that threaten human safety or welfare of wildlife, especially if using lead-free ammunition would result in prolonged unrelieved pain and suffering of the animal. The memo also provides exception for special circumstances for wildlife management when non-lead ammunition is unavailable, or not safe under the specific circumstances (Memorandum, Director USFWS, dated October 3, 2016, FWS/ANRS-NRCP/063775).

WS-Colorado continues to review the availability and performance of non-lead ammunition options relative to program safety and ammunition performance needs and, as effective ammunition becomes available, will consider its use where appropriate. However, as the impacts of using non-lead ammunition would be less than that evaluated in Sections 3.2 and 3.4, this EA would still be valid if WS-Colorado began using more non-lead ammunition.

2.10.15 Conduct Short-Term Suppression of Populations with Goal of Long-Term Eradication

An eradication alternative would direct all WS-Colorado's program efforts toward long-term elimination of selected predator populations wherever a cooperative agreement has been initiated with WS-Colorado. Eradication of a native predator species is not a desired population management goal of state or federal agencies and is outside the authority of APHIS-WS. WS-Colorado does not consider eradication or suppression of native wildlife populations a responsible or effective strategy for managing predator damage because APHIS-WS policy and authority is to manage offending animals or multiple animals within the area of damage. CPW has the authority to manage population levels of regulated species of wildlife through hunting and trapping seasons and depredation permits. WS-Colorado may assist CPW as its agent for meeting specific CPW management objectives when requested, but that type of activity is generally in small areas for protection of specific subpopulations of selected game animals consistent with CPW management objectives set with public input.

Therefore, this alternative will not be considered in detail.

2.10.16 Conduct Supplemental or Diversionary Feeding

Supplemental feeding involves providing supplemental acceptable food plots or bait stations either during certain annual periods when damage is occurring or on a year-round basis to lure the animal away from the locations of protected resources. This alternative is inefficient at best, and would most likely lead indirectly to increased damage. Supplemental feeding of carnivores would require a ready and consistent supply of meat, including animal carcasses, and placing those carcasses in areas that predators may be using. These sites could become a public nuisance, inappropriately attract large numbers of predators to a small area, increase intra- and inter-species competition, and require a large and continuous effort.

Supplemental feeding may increase predator populations and alter their natural diets (Fedriani *et al.* 2001, Newsome *et al.* 2015); decrease survival rates of targeted populations when food subsidy is removed (Bino *et al.* 2010, Newsome *et al.* 2015); predator populations no longer cycle with prey populations, changing life history parameters such as reproduction and social structure, size of home ranges, activity, and movements (Newsome *et al.* 2015); change interactions with other predator species, and create long-term changes in disease transmission (Newsome *et al.* 2015).

Therefore, this alternative, is not considered in detail.

2.10.17 Conduct Biological Control of Predator Populations

The introduction of a species or disease to control another species has occurred throughout the world. Unfortunately, many of the introduced species become invasive species and pests themselves. For example, in Hawaii, the Indian mongoose (*Herpestes auropunctatus*) was introduced to control rats (*Rattus* spp.), but caused declines in many native Hawaiian species instead, primarily because the target species were nocturnal and mongoose are diurnal. WS-Colorado is not authorized to conduct this type of work and would not use this method for PDM. Therefore, this alternative is not considered in detail.

2.10.18 Use Lithium Chloride as an Aversion Agent for Coyote Depredating on Sheep

Lithium chloride has been tested as a taste aversion agent to condition coyotes to avoid livestock, especially sheep. Despite extensive research, the efficacy of this technique remains unproven and is highly variable (Conover *et al.* 1977, Sterner and Shumake 1978, Burns 1980, Burns and Connolly 1980, Burns 1983, Horn 1983, Johnson 1984, Burns and Connolly 1985). Some studies report success using lithium chloride (Gustavson *et al.* 1974, 1982; Ellins and Martin 1981; Gustavson *et al.* 1982, Forthman-Quick *et al.* 1985), while other studies have shown lithium chloride to be ineffective especially in field situations (Conover *et al.* 1977; Burns 1980, 1983; Burns and Connolly 1985) and controlled experiments (Sterner 1995). The General Accounting Office (GAO) (2001) reported "…while the coyotes learned not to eat lambs, they still killed them."

In addition, lithium chloride is currently not registered by for use by the EPA, and therefore cannot be used or recommended for this purpose. If a product containing lithium chloride is registered in Colorado to manage predator damage and if the product is proven effective in reducing predation rates, the use of the lithium chloride could be subsequently evaluated as an available method that could be used to managing damage. If WS-Colorado considers using a product containing lithium chloride, WS-Colorado would update its NEPA analysis accordingly.

Therefore, this alternative is not considered in detail.

2.10.19 All Losses Confirmed by an Independent Entity (Not WS-Colorado)

Some commenters request that all livestock losses be confirmed by an entity independent of WS Colorado prior to WS-Colorado taking any action, especially lethal action.

In order to accurately identify the species, and even the animal(s) that has caused a damage or depredation situation, the on-site verification must occur quickly after that event has occurred before the evidence is degraded or removed/consumed by a returning predator. Action to remove the offending animal must also occur quickly, in order to actually address the specific animal, and not, for example, a scavenger. Waiting for an independent entity to verify a depredation event and the animal(s) creating it may result in the inability to verify at all. Also, no entity with the expertise, experience, training, and resources exists in Colorado, other than commercial enterprises that focus on predators less than or equal to the size of coyotes.

In addition as coyotes are regulated in Colorado as "predators," private landowners or managers may take predators in protection of property on private land. This requirement is also outside the scope of this EA as WS-Colorado has no authority to implement an independent process for verifying livestock losses.

Requiring entities other than WS-Colorado to confirm losses could delay responding to requests for assistance. Such a delay could result in individuals deciding to take action, which may result in more predators taken than the offending animal, such as scavengers or other predators in the area, or the offending species. It could also prevent resolution of the problem because the remaining evidence might be too degraded for anyone to make a reliable determination of the cause.

Therefore, this alternative will not be considered in detail.

2.10.20 Producers Avoid Grazing Livestock in Areas of Predator Activities and Ensure Herders Constantly Present

APHIS-WS does not have authority to require ranchers where and how ranchers graze or their livestock on private or federal land. However, WS-Colorado may make reasonable recommendations on animal husbandry methods to reduce the risk of depredation.

Producers, to the extent practicable, work to avoid grazing livestock near predator dens and rendezvous sites. However, producers have no control over whether or not predators establish dens or rendezvous sites near their livestock, and with some common predators, such as coyotes, it may be virtually impossible to avoid grazing "near" dens, especially for producers grazing on private lands. Producers may not have the option to move their livestock elsewhere either because they have limited access to substitute grazing lands or because the land management agency establishes the timing and movements for permitted livestock. To minimize environmental concerns on grazing lands, cattle are not maintained in tight herds as it often is with bands of sheep, further limiting options to move livestock. In dry years, in order to minimize risk of adverse effects on range, producers may spend shorter times in any given area but they then need to use all or most portions of their allotments instead of avoiding areas with a history of predator conflicts.

WS-Colorado also does not have authority to require ranchers to hire herders for livestock, although it might recommend that strategy as part of technical assistance using the APHIS-WS Decision Model. Nonetheless, sheep producers routinely use herders with their animals to keep them together in a band and moving through the grazing areas; herders are seldom used for cattle operations on public lands because the risk of predation is lower once calves reach a certain size. Due to the dispersed nature of cattle grazing, herders are not an effective management strategy, but range riders can help reduce risks of predation by moving cattle away from areas of high predation risk and promptly identifying animal health and predation incidents so they can be addressed to minimize livestock losses (Parks and Messmer 2016).

WS-Colorado responds to requests for PDM assistance from producers with large herds/flocks that graze on open range and producers with small herds/flocks in fenced pastures. The use of herders represents a substantial financial obligation, and may not be cost effective for producers with smaller herds/flocks (Parks and Messmer 2016). For producers with small flocks in fenced pastures, it may be better to incur a one-time investment in installing quality fencing that would last for years than the annual expense of a herder.

This alternative is not considered for further analysis because it mandates a specific set of management alternatives for all producers, which is impractical.

2.10.21 Use Bear Repellents in Lieu of Lethal Bear Removal

Capsaicin (concentrated red pepper spray) has been tested and used effectively on black bears, primarily as an emergency personal protective repellent primarily by recreationists in the backcountry. The spray range on most products is less than 30 feet, so capsaicin is only effective in close encounters and is not appropriate for long-term management of bear damage or threats to public and pet safety. The use of capsaicin pepper spray is not effective PDM tool and, because it must be used at close range to the depredating animal, may be extremely dangerous.

Therefore, this alternative is not considered in detail.

2.10.22 Livestock Producers Pay 100% of WS-Colorado Assistance Involving Lethal Removal

The intent of this alternative is to ensure that lethal removal is not subsidized by federal taxpayer funds, thereby encouraging livestock producers to decide whether their funds are more effective if applied to non-lethal methods.

Under all alternatives in which WS-Colorado provides lethal and/or non-lethal assistance, preference is already given to non-lethal methods in accordance with WS Directive 2.101. In many instances, WS-Colorado is contacted after entities have unsuccessfully attempted to resolve their damage or threats on their own with non-lethal and/or lethal methods.

APHIS-WS is authorized by federal law and funded by both Congressional appropriations and funds provided by entities that enter into cooperative agreements with APHIS-WS state offices for assistance.

WS-Colorado already provides technical support to all requesters and operational support (Alternative 1), including lethal assistance to some degree under all alternatives as determined appropriate, except Alternative 4.

Therefore, this alternative is contrary to agency policy and will not be considered in detail.

2.10.23 WS-Colorado Prohibited from Operating on Federal Lands

The USFS and BLM recognize the importance of effective PDM actions on lands under their jurisdiction. USFS and BLM maintain MOUs with APHIS-WS at the national level. These MOUs provide for direct requests from livestock permittees or state agencies to the respective APHIS-WS state agency for preventive and corrective assistance.

Per the national interagency MOUs, the agencies coordinate annually to cooperatively develop updated ADMs, including designating appropriate restrictions to ensure that PDM actions do not conflict with land use plans.

Producers leasing grazing allotments on federal lands, natural resource managers working to protect sensitive or ESA-listed species, and federal agency officials responding to threats to human/pet health or safety associated with predators on federal lands that they manage have legal access to the same types of damage management methods as would be used by WS-Colorado, with the exception of M-44s. In the last five years, WS-Colorado has not set any M-44s on public lands and therefore has had no associated predator take. Only 6% of all coyote take by WS-Colorado in the state has occurred with M-44s because of limited application. M-44s are primarily used to capture coyotes that have proven difficult to capture using other methods.

PDM can and is being conducted on federal lands by entities other than WS-Colorado. Coyotes can be taken when causing depredation or are a risk to human safety per state law. Public hunting and trapping, as regulated by CPW, legally occurs on public lands unless otherwise restricted (such as in National Parks).

Some predator species, such as coyotes, may be taken by the public, permittees, or other agencies experiencing depredation in the same manner as actions by WS-Colorado (except for the use of M-44s) without any requirement to report take to CPW, unless they are taken under an aerial PDM permit issued by CDA. Depending on the training and experience of the individuals conducting the work, selectivity of these actions for target species and target animals, especially older territorial adult coyotes that are typically more difficult to capture than younger individuals, may be lower than for a program conducted by trained personnel from WS-Colorado (Sacks *et al.* 1999a, 1999b, Larson 2006).

This issue is outside the scope of APHIS-WS authority. Therefore, this alternative is not considered in detail in this EA.

2.10.24 No PDM Within any Designated Wilderness Areas (WAs) or Wilderness Study Areas (WSAs)

WS-Colorado currently conducts very little PDM in Wilderness Areas (WAs) or Wilderness Study Areas (WSAs), and this low level is not expected to increase significantly in the future under Alternative 1. The amount of PDM activities that is expected to occur in designated wilderness areas, proposed wilderness areas, and WSAs is either none, or so minor that the effects of any of the alternatives that involve no WS-Colorado lethal work would not likely be significantly different from the effects of a "No Control in Wilderness Areas" alternative. Some wilderness, proposed wilderness and WSAs in Colorado have historic grazing allotments. Historically, WS-Colorado has conducted PDM activities in the Weminuche WA. WS-Colorado has also been requested to conduct PDM activities in Lizard Head WA and Powder Horn WA; however, PDM has not been conducted in these WAs. The minor amount of PDM activities that could be conducted by WS-Colorado in wilderness, proposed wilderness, or WSAs conforms to legislative guidelines, and MOUs between APHIS-WS and the responsible land management agencies.

WS-Colorado and the land management agency coordinate annually to review and update ADMs which delineate what, when, why, where, and how PDM would be conducted, as discussed in Section 1.14.1. In WAs, APHIS-WS uses the minimum lethal management necessary when conducting PDM activities per BLM and FS policy. Also, to the extent possible, the control of predators causing livestock loss is limited to the individual(s) causing the damage (corrective rather than preventive actions).

As evaluated in Section 3.5.1, such control activities meet the non-impairment criteria for wilderness characteristics and therefore do not adversely affect wilderness characteristics. Also, Congressional legislation for designation of each WA specifically addresses restricted and allowable actions. Some USFS and BLM land management plans also address PDM on lands under their jurisdiction, as appropriate.

This alternative is better addressed through the political process at the federal level or directly with the appropriate USFS or BLM office. Therefore, this alternative is not considered in detail.

2.10.25 WS-Colorado Contracts PDM Activities to the Commercial Sector or Defers All PDM Activities to CPW

This alternative requires WS-Colorado to award and oversee contracts for PDM activities to the commercial/private sector; WS-Colorado would not conduct any technical or direct lethal or non-lethal assistance. All legally authorized methods would also be authorized in such contracts. WS-Colorado would retain contracting responsibilities, provide oversight to ensure that PDM is implemented according to the statement of work, and document target and non-target take as reported by the contractor. As the authorized federal agency, WS-Colorado would continue to be responsible for environmental and NEPA compliance. Private contractors would not be contracted to use M-44s.

CPW is often the first to be requested and to respond to damage caused by bears and cougars, and can either do the work itself, hire commercial companies or individuals, or enter into an agreement with WS-Colorado. Any PDM work not conducted by WS-Colorado, or conducted or authorized by another federal agency, would not require compliance with NEPA.

WS-Colorado does not contract its authorized activities to other entities, including commercial entities. Private companies and individuals may already be hired directly by requesters to conduct PDM activities. WS-Colorado would not assume any responsibility or liability for actions conducted by any other entity.

Therefore, this alternative will not be considered in detail.

2.10.26 Modify Habitats to Reduce Predation

WS-Colorado may recommend habitat modification as part of its technical assistance activities (WS-Colorado does not conduct this type of activity itself) in all alternatives having WS-Colorado involvement. The land/resource owner is responsible for ensuring that any necessary permits are acquired prior to taking any such action on their private land. Also, federal and state land management agencies have the authority to conduct habitat management.

As this strategy is already included in all the alternatives considered in detail, except the "No Program" alternative (Alternative 4), this alternative will not be considered further as an independent alternative.

2.10.27 Make Supplemental Payments to Livestock Producers: The Marin County, CA Experiment

Following public opposition over the use of lethal methods to control coyote predation, the Marin County, California Board of Supervisors replaced a cooperative program with the California Department of Food and Agriculture and the U.S. Department of Agriculture with a county-administered, non-lethal program supervised by the County Agricultural Commissioner.

Under the current non-lethal Marin County Program, qualified ranchers are provided cost-share funding to assist in the implementation of non-lethal management methods to reduce depredation such as through new fence construction or improvements to existing fences, guard animals, scare devices, or changes in animal husbandry. The most commonly used methods by producers are guard dogs and fencing (Larson 2006). To qualify for the program, ranchers must have at least 25 head of livestock and must use two non-lethal methods to deter predation, as verified by the Marin County Agricultural Commissioner.

Initially, producers who qualified for the program could also receive compensation for livestock lost to predation. However, the program was unable to pay the cost of all losses to predation and, in 2003, compensation payments were capped at 5% of the number of adult animals in the herd. However, when the Marin County Department of Agriculture, in a December 2014 California Public Records Request, was asked for records reflecting whether and to what extent the Program addresses or pays for the depredation of, or damage caused by, coyotes, mountain lions (cougars), feral swine (wild hogs and boars), free roaming and/or feral dogs, gray fox, striped or spotted skunks, possums, and other common wild animals, Marin County indicated that the Livestock Protection Program was only a cost-share program to provide limited funds for purchasing fencing materials and guard animals.

Animal advocates have referred to the Marin County program as "a model program" that has successfully addressed and embraced ethical concerns, as well as the differing values of the ranching and animal protection communities (Fox 2001, Fox 2006). However, this positive opinion of the County program is not necessarily shared by Marin County or the greater California livestock community (Larson 2006).

Although Marin County's program is discussed as a "non-lethal" approach and appears to be less lethal on its surface, a study evaluating the effectiveness of the Marin County program (Larson 2006) indicated that more coyotes have been killed during the implementation of the Marin County Program compared to the standard APHIS-WS cooperative program. This is due, in part, to the fact that landowners are not prohibited from killing coyotes on their land or hiring others to do so. Individual producers and others working on their behalf routinely practiced snaring, calling and shooting, and denning in an effort to kill damage-causing coyotes. Larson (2006) also indicated that it is likely that some ranchers are taking more coyotes than when the WS-California program was in place, because WS-California personnel would recommend that landowners not take action in order to avoid creating animals that are wary of capture methods applied by non-experienced people.

Research conducted in nearby Mendocino County, California, and elsewhere indicates that territorial, dominant (alpha) coyote pairs, the most difficult to capture by snaring or trapping, cause the majority of livestock losses, especially when adults are raising (multiple authors cited in: Jaeger 2004, Sacks *et al.* 1999a, 1999b). Experienced field specialists from APHIS-WS are likely to be more effective at targeting specific problem coyotes than less experienced members of the public who are more likely to remove less problematic, but easier to capture or kill, juvenile and subordinate coyotes (Larson 2006). In addition, landowners are rarely trained, experienced experts in professional trapping techniques and are more likely to capture non-target species during their efforts (Larson 2006). Because the Marin County program has no means of collecting data from landowners on use of lethal methods or take numbers, there is no way to quantify the take of target and non-target animals (including state and federally listed threatened or endangered species) nor evaluate the environmental impacts of such take. The APHIS-WS program uses the MIS database to effectively track the equipment, and target and non-target take associated with all operational PDM projects.

A review of Marin County's budget over the first five years of the non-lethal program's implementation found that on average the program cost Marin County 1.2 times the amount that the cooperative APHIS-WS PDM program cost the county in its highest year (Larson 2006). These budget evaluations only record the county's cost for implementation, and do not capture the additional landowner costs associated with this program. The inability of the program to pay compensation for all livestock losses and the need to cap loss indemnity payments are also noteworthy.

The Marin County program is limited to providing financial compensation assistance with non-lethal PDM to protect sheep operations larger than a certain size. It does not address several of the needs for action that WS-Colorado works on as identified in Chapter 1, including protecting cattle and calves, work at airports, protection of public/pet health and safety, and protection of natural or commercial resources, including ESA-listed species. Furthermore, non-lethal methods do not always resolve predator damage problems, even for sheep operations.

Based on the limitations of the Marin County program noted by Larson (2006) and summarized above, such an alternative would fail to address all needs for action presented in Chapter 1. Moreover, APHIS-WS and Colorado-WS have no authority to implement such a program. The budgets and decisions of state, county, and local governments are outside of the authority and control of WS-Colorado and APHIS-WS. There is also no Congressional authority to provide such subsidies to cooperators; thus, a similar federal program is outside the authority of WS-Colorado and APHIS-WS. WS-Colorado has determined that detailed analysis of this alternative would not provide substantive new information to aid decision-making and will not be conducted at this time. A similar program could be implemented by local, county, or state governments in Colorado at their discretion.

2.10.28 Suspend Lethal Removal of Predators to Protect Livestock Until More Rigorous Scientific Testing Shows Methods to be Effective at Reducing Predation

See Section 1.18.3 and Appendix E for detailed discussions of the Treves *et al.* (2016) recommendations. This alternative will not be considered for detailed analysis for the reasons discussed therein.

2.11 Protective Measures

Protective measures are standardized instructions intended to avoid unwanted results. APHIS-WS and WS-Colorado incorporate numerous protective measures when conducting PDM in order to prevent, reduce, or compensate for negative impacts that otherwise might result from an action. Relevant protective measures would be incorporated into all Alternatives analyzed herein, except the no federal PDM program alternative (Alternative 4). Most protective measures are instituted to abate specific issues, but some are more general and relate to the overall program. Some of these measures are recommended or required by regulatory agencies (*e.g.*, EPA), and these are listed where appropriate. Additionally, specific measures to protect resources such as T&E species which are managed by WS-Colorado's cooperating agencies (USFWS and CPW) are included in the lists below.

2.11.1 General Protective Measures Used by WS-Colorado in PDM

- WS complies with all applicable laws and regulations that pertain to working on federally managed lands.
- WS coordinates with Tribal officials for work on Tribal lands to identify and resolve any issues of concern with PDM.
- The use of PDM methods such as traps and snares conforms to applicable rules and regulations administered by the State, as well as WS Directives.
- WS personnel adhere to all label requirements for toxicants and pesticides. EPA approved labels provide information on preventing exposure to people, pets, and T&E species, along with environmental considerations that must be followed. WS personnel abide by these restrictions.
- The WS Decision Model (Slate *et al.* 1992) is consistently used by WS employees when determining appropriate WDM methods. This Model is designed to identify effective wildlife damage management strategies as well as their impacts.

2.11.2 WS Protective Measures Specific to the Issues

The following is a summary of the protective measures used by WS-Colorado which are specific to the issues listed in Section 2.2 of this EA.

2.11.2.1 Impacts on Populations of Target Species.

- PDM is directed toward localized populations or individual offending animals, depending on the species and magnitude of the problem, and not an attempt to eradicate any native wildlife population in a large area or region.

- WS-Colorado Specialists use specific trap types, lures, and placements that are most conducive to capturing the target animal with the least amount of injury, consistent with WS Directives 2.101, 2.105, 2.450, and 2.455.

- Decisions to kill problem bears, mountain lions, foxes, bobcats, coyotes, raccoons, opossums, and striped skunks damaging agricultural resources are made by WS-Colorado under the authority of CDA. All other species are controlled under CPW authority. Decisions to translocate any species is coordinated with CPW. CPW is notified in a timely manner of all take for big game species such as black bear and mountain lion.
- WS-Colorado will use Best Management Practices for Trapping by using approved foot-hold, restraining, and kill traps to capture predatory animals.
- WS-Colorado will only use passive non-lethal PDM measures to alleviate wolf predation while they are listed as an endangered species. These might include fencing, fladry, pyrotechnics, lasers, effigies, moving livestock, range-riding, and strobe-sirens. No methods which might injure, harm, or kill a wolf will be used. WS-Colorado might use foothold traps to capture wolves at the request of CPW or USFWS to place a GPS or UHF radio-collar on the wolf for monitoring.
- WS-Colorado will follow any 10(j) or 4(d) rules to manage wolves depredating livestock or pets. Should gray wolves or Mexican wolves be delisted under the ESA then WS-Colorado shall follow statutes put in place by the State of Colorado to conserve wolves.

2.11.2.2 Impacts on Populations of Non-target Species.

- WS-Colorado personnel are trained to select the most appropriate method(s) for taking problem animals with little impact on non-target species.
- WS-Colorado personnel work with research programs such as the WS National Wildlife Research Center to continue to improve the selectivity of management devices.
- Traps and snares are not set within 30 feet of exposed carcasses (*i.e.*, "draw stations") in order to prevent the unintentional capture of scavenging birds such as bald eagles and ravens. The only exception to this policy is for the capture of target mountain lion, black bear, or raptors (bear and lion sets are selective for large heavy animals due to pan-tension devices, and raptor sets are specifically intended to capture these birds).
- Pan-tension devices for foot snare triggers and foot-hold traps are used by WS-Colorado, as appropriate, throughout Colorado to reduce the capture of non-target wildlife that weigh less than the target species.
- Breakaway snares, designed to break open and release when tension is exerted by a larger non-target animal such as deer, antelope or livestock, have been developed and are being refined. These snares will be implemented into the WS-Colorado program as appropriate.
- Non-target animals captured in foot-hold traps or foot snares are released at the capture site unless it is determined by WS-Colorado Specialists that the animal is not capable of self-maintenance.
- PDM activities are directed at towards individual problem animals, or local populations, to resolve damage problems associated with them.
- When working in an area that has T&E species or has the potential for T&E species to be exposed to PDM methods, WS-Colorado personnel will know how to identify sign of the target and T&E species (*e.g.*, bobcat *vs* lynx), and apply PDM methods accordingly.

2.11.2.3 Measures to Reduce the Potential Take of Specific T&E Species

Kit Fox. WS-Colorado follows CPW's guidelines for minimizing the potential to take kit fox in their range as defined in CPW's regulations. In kit fox range, WS-Colorado uses pan-tension devices on foot-hold traps, and snares with stops or an 11+" loop. Traps and snares are checked daily, and the use of M-44s is not allowed. If WS-Colorado targets a kit fox because of damage, CPW will be notified to determine if it should be translocated.

Canada Lynx. WS-Colorado abides by the December 7, 2009 BO obtained from the USFWS (USFWS 2009). Currently, WS-Colorado has been provided general habitat maps and guidance from CPW for this purpose. CPW conducted a predictive analysis of habitat used by lynx in Colorado and found lynx strongly associated with spruce-fir forests at high elevations (above 9,000 feet) with deep snow during winter months (Ivan *et al.* 2011). The maps that CPW develops provide a good insight as to where lynx can be expected to occur (Ivan *et al.* 2011). The best winter habitat for lynx in Colorado was predicted to be the San Juan, Culebra, and Wet Mountain ranges in southern Colorado, Sawatch and West Elk mountain ranges along the Grand Mesa, and Park Range and Flat Tops in northern Colorado (Ivan *et al.* 2011). Summer habitat was similar to winter habitat with some stronger associations including the use of lodgepole pine and aspen habitat in the Sawatch Range of central Colorado and the use of the Medicine Bow and Front Range of northern part of Colorado (Ivan *et al.* 2011). We believe that PDM implemented by WS-Colorado continues to be the same as that identified in the 2009 BO. CPW has agreed to keep WS-Colorado informed of unusual lynx locations in Colorado so that WS-Colorado personnel can take steps to avoid their incidental capture. When WS-Colorado personnel conduct PDM in lynx habitat (primarily higher elevation areas of USFS NFs where they have been found), shooting will be the preferred method whenever it can be used practically and effectively to resolve a problem situation, because it poses virtually no risk of incidental lynx take. Further restrictions on WS-Colorado PDM methods to avoid lynx take that are now part of WS-Colorado protective measures while operating under the December 7, 2009 BO are as follows.

- All WS-Colorado personnel conducting PDM in or near lynx occupied habitat will be trained in identification of lynx and lynx sign, and snowshoe hare and their sign if conducting PDM in lynx habitat.
- No fetid baits or attractants will be used in coyote trap sets within lynx habitat.
- No neck snares may be used for capturing coyotes or bobcats within lynx habitat; neck snares for capturing lions, bears, and (if and when they occur in the state and WS-Colorado is authorized to capture them) wolves may be used within lynx habitat if they are equipped with "stops" (to prevent the snare loop from closing down below a size that could choke or otherwise hold a lynx).
- WS-Colorado will not use M-44 devices or Large Gas Cartridges within lynx habitat.
- WS-Colorado must remove any tracking dog from trailing a lynx.
- WS-Colorado must immediately release any incidentally captured lynx after notifying the USFWS or CPW, if practical, unless the lynx has been injured and cannot be rehabilitated or safely released, at which point it may be euthanized after USFWS approval. If an injured lynx can be rehabilitated, it will be transferred to the USFWS or CPW, or a licensed wildlife rehabilitation center as directed by USFWS or CPW.
- WS-Colorado must report details of any trapped, lethally taken, lynx, and all lynx-related observations to the nearest USFWS office and CPW, and must make efforts to

contact the USFWS when a lynx is captured alive to determine if the lynx should be radio-collared, or released immediately.

- WS-Colorado must notify appropriate CPW and USFWS offices within 24 hours if a lynx is killed and must assist in preserving and transporting the carcass to the appropriate agency for analysis.
- If lynx are delisted as a federally protected species under ESA then all restrictions will be re-negotiated with CPW. WS-CO will follow any new restrictions put in place by the State of Colorado to conserve lynx.

River Otter. To avoid taking river otter, WS-Colorado does not trap along lake shores, streams, and rivers where river otter sign is found except with: a) padded-jaw foot-hold traps; b) Conibear® type traps less than 220 in size; or c) land or water set snares with a closure size of 16 inch circumference or larger.

In addition, padded-jaw traps and snares are not used in drowning sets; padded jaw traps and land set snares may only be set in accordance with the provisions of 33-6-205 CRS, 33-6-206 CRS, or 33-6-207 CRS; and water set snares and Conibear® traps may only be set in accordance with the provisions of 33-6-205, CRS, or 33-6-207 CRS.

Gray Wolf. WS-Colorado has adopted and implemented conservation measures outlined in 2016 to protect gray wolves. These measures would also protect Mexican gray wolves, should they wander into Colorado (WS 2016b).

- WS-Colorado will contact USFWS's or CPW's Gray Wolf Coordinator to verify any WS-Colorado sightings of gray wolves in Colorado. Colorado has almost 7,000 captive wolf-dog hybrids, which could potentially could be one of these released into the wild.
- WS-Colorado will not use M-44s or neck snares in the "occupied gray wolf range or conservation areas." Occupied gray wolf range is defined as: (1) an area in which gray wolf presence has been confirmed by state or federal biologists through interagency wolf monitoring programs, and USFWS has concurred with the conclusion of wolf presence, or (2) an area from which multiple reports judged likely to be valid by USFWS have been received, but adequate interagency surveys have not yet been conducted to confirm presence or absence of wolves. One conservation area has been identified in Colorado as the area south of the Wyoming border on Highway 13 to Craig, then east on Highway 40 to Steamboat Springs, then south on Highway 131 to Interstate 70, then east to Interstate 25, then north to the Wyoming border and finally west along the Wyoming border back to Highway 13. Wolves have been sighted occasionally over the last several years in this area.
- WS-Colorado will check all foot-hold traps and foot-hold snares at least once a day in areas known to be occupied by gray wolves. This monitoring may be conducted electronically.
- WS-Colorado may use break-away snares with stops that are checked at least once a day in areas known to be occupied by gray wolves. This monitoring may be conducted electronically.
- WS-Colorado will use night vision or thermal imaging when conducting calling-and-shooting at night in areas occupied by gray wolves.
- WS-Colorado will require that Specialists involved in aerial PDM and ground shooting in areas where gray wolves have been documented will receive additional training to

differentiate wolves from coyotes. Further, no aerial PDM will occur in occupied gray wolf habitat from 01 September – 30 November.

- WS-Colorado will abide by all applicable reasonable and prudent alternatives, measures, and terms and conditions required as a result of findings in any ESA consultations between WS-Colorado and USFWS.
- WS-Colorado may assist the Wolf Recovery Team, CPW, or CDA in trapping wolves so that they can be examined. The use of immobilizing drugs to capture a wolf will only be conducted by WS-Colorado personnel certified in the use of these drugs.
- In the event that a wolf has been found to kill livestock in Colorado, WS-Colorado will verify and document the predation, obtain pertinent evidence such as photographs, and contact the USFWS Wolf Recovery Team. Should the Recovery Team determine that the offending individual(s) must be removed, it is likely that WS-Colorado would be asked by the Recovery Team to initiate PDM activities to abate damages caused by the offending wolf or wolves. This would be completed for USFWS under separate NEPA documentation and the appropriate permit.
- WS-CO will manage gray and Mexican wolves according to their legal classification. We will follow USFWS regulations while wolves are a listed endangered or threatened species, including following any 10(j) or 4(d) rules. Should either wolf species be federally delisted from the ESA then WS-CO will follow Colorado statutes on managing wolf predation incidents.
- Non-depredating wolves incidentally caught will be released unharmed at the capture site.

Wolverine. Wolverines may have been extirpated from Colorado, and WS-Colorado has not taken any in the last few decades. If WS-Colorado personnel sight a wolverine, or verify tracks or other sign, we will notify CPW. In the immediate area of a wolverine identified by WS-Colorado or CPW, WS-Colorado may still use padded jaw foot-hold traps and snares with stops checked daily, but not M-44s. WS-Colorado will determine further measures that will reduce the potential for take with CPW if one is found.

California Condor. If a California condor is seen in Colorado outside of the designated experimental range in Arizona, WS-Colorado will contact the USFWS. Currently, M-44s are not used in a 5 mile corridor around the Colorado and San Juan Rivers from March 1 to October 1, because three condors were seen near Grand Junction in the summer of 1998 (USFWS 2001).

Burrowing Owl. WS-Colorado employees using gas cartridges to fumigate a coyote or red fox den will ensure that dens are occupied by the target species, and not by burrowing owls.

Plains Sharp-tailed Grouse, Lesser Prairie-chicken, and Gunnison's Sage-grouse. WS-Colorado will use pan-tension devices on foot-hold traps in habitat occupied by these grouse species to minimize their potential capture. Small predators of similar weight as these sensitive species will be live captured in cage traps in these areas.

2.11.2.4 Measures to Ensure Minimal Impacts from Aerial PDM Overflights.

WS-Colorado pilots will abide by the WS Aviation Policy Manual and Federal Aviation Regulations. Non-target wildlife will not be pursued and will be avoided whenever seen.

2.11.2.5 Impacts on Ecosystem Function

- WS-Colorado only responds to wildlife damage; once the damage has been mitigated, WS-Colorado discontinues activities. WS-Colorado PDM activities are short in duration, with minimal impact on plant and animal communities, negating any potential impact on ecosystem function.
- WS-Colorado conducts environmental analyses as required under NEPA to insure that any potential impacts are limited to local populations.

2.11.2.6 Impacts on Human and Pet Health and Safety.

- Public safety zones are delineated and defined by location in ADMs, or on ADM maps by BLM and USFS during the work-planning meeting. These zones are updated as warranted by land use changes. The public safety zone is one-quarter mile, or other appropriate distance, around any residence or community, county, state or federal highway, or developed recreation site. PDM conducted on federal lands within identified public safety zones will generally be limited to activity aimed at the protection of human health and safety. However, a land management agency or cooperator could request PDM activities in the public safety zone for an identified need. Depending on the situation and applicable laws and regulations, WS-Colorado could provide the service. However, land management agencies would be notified of PDM activities that involve methods of concern such as firearms and dogs before these methods would be used in a public safety zone, unless specified otherwise in the ADM and deemed appropriate.
- All pesticides used by WS-Colorado are registered with EPA and CDA. WS-Colorado employees will comply with each pesticide's directions and labeling, in addition to EPA and CDA rules and regulations.
- WS-Colorado Specialists who use restricted use chemicals (pesticides or drugs) are trained and certified by program personnel or other experts in the safe and effective use of these materials under EPA and CDA approved programs. WS-Colorado employees who use these chemicals participate in continuing education programs to keep abreast of developments and to maintain their certifications.
- M-44's are only used by those WS-Colorado personnel who are trained and have received state certification from CDA to use sodium cyanide. PDM activities that involve the use of these chemicals are conducted in accordance with CDA and EPA regulations as well as label restrictions and other protective measures related to protection of non-target or sensitive species.
- Conspicuous, bilingual warning signs (English and Spanish) alerting people to the presence of traps, snares, and M-44s are placed at major access points when they are set in the field.
- M-44s are only used on private lands.
- M-44s will be set no closer than ¼ mile to a residence, except a residence owned by the cooperator.

2.11.2.7 Impacts on Use of Public Lands.

- WS-Colorado will conduct PDM on SMAs only when and where requested by the land management entity. All PDM activities conducted in SMAs including WAs and WSAs would be in accordance with the MOUs between WS-Colorado and the land management agencies, and all enacted rules and regulations that are applicable to WS-Colorado.

- WS-Colorado personnel follow all laws and regulations applicable to WS-Colorado and use the WP guidelines while conducting PDM activities on public lands. The WPs include delineation of areas where certain methods may not be used during certain time periods when conflicts with recreational events may occur. If it were necessary to work in areas outside the planned area, the area manager or their representative would be contacted in a timely manner.
- WS-Colorado conducts PDM in accordance with all laws applicable to WS-Colorado associated with public lands and for the areas specified in BLM RMPs and USFS LRMPs. The land managing agencies review the WPs for consistency with their Plans.
- Vehicle access will be limited to existing roads, unless off-road travel is specifically allowed by the land managing agency and conforms with RMPs and LRMPs.
- PDM in WAs will be in accordance with Wilderness Policies and MOUs applicable to WS-Colorado PDM activities.
- WS-Colorado does not anticipate conducting PDM in National Parks. The potential exists that a request could come from the National Park Service (NPS) or CPW for responding to a threat to human health and safety or for research purposes. If WS-Colorado conducts PDM in response to such a request, the work will be done according to a WP agreed to by NPS, which will specify any restrictions on methods or locations.
- Should any of BLM's existing WSAs be officially designated as Wilderness Areas in the future, PDM will be performed in accordance with the enacting legislation and Wilderness rules and regulations that pertain to WS-Colorado PDM.
- M-44s will not be used on public lands.

2.11.2.8 Impacts on Other Sociocultural Issues.

- WS-Colorado will consult with Native American tribes prior to conducting PDM on tribal lands.

<u>Humaneness and Ethical Perspectives</u>.

- Chemical immobilization and euthanasia procedures that do not cause pain or undue stress are used by certified personnel when practical and where safe.
- WS-Colorado personnel attempt to kill captured target animals that are slated for lethal removal as quickly and humanely as possible. In most field situations, a shot to the brain with a small caliber firearm is performed which causes rapid unconsciousness followed by cessation of heart function and respiration. A well placed shot to the head is in concert with the American Veterinary Medical Association's definition of euthanasia (AVMA 1987, 2001, 2013). In some situations, accepted chemical immobilization and euthanasia methods are used.
- Traps are set and inspected according to CDA or CPW regulations and WS policy.
- Research continues with the goal of improving the humaneness of PDM devices.

CHAPTER 3. ENVIRONMENTAL CONSEQUENCES

Chapter 3 provides the information needed for making informed decisions in selecting the appropriate alternative for meeting the need for PDM in Colorado as identified in Chapter 1. This chapter analyzes the environmental consequences of each of the four alternatives discussed in Chapter 2, in relation to the six issues identified for detailed analysis in Chapter 2. The proposed action/no action alternative (Alternative 1) serves as the baseline for the analysis, which is described in Section 1.16.4. Alternatives 2, 3, and 4 are compared to the proposed action (Alternative 1) for each issue to determine if real or potential impacts would be higher, lower, or approximately the same.

The analyses in this Chapter are based on direct, indirect, and cumulative impacts. Direct impacts are caused by the action and occur at the same time and place. Indirect impacts are caused by the action and are later in time or farther removed in distance. Indirect impacts may include effects related to induced changes in population density, ecosystems, and land use changes. Cumulative impacts, as defined by CEQ (40 CFR 1508.7), are "impacts to the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions." Cumulative impacts may result from individually minor, but collectively significant, actions taking place over time. In these analyses, we have included all known and foreseeable actions which could add to cumulative impacts.

As discussed in Chapter 2, there are six issues to be analyzed in detail. For each issue, the four alternatives are analyzed. The issues are:

- Issue A: Impacts on Populations of Target Species
- Issue B: Impacts on Populations of Non-target Species
- Issue C: Impacts on Ecosystem Function
- Issue D: Impacts on Human and Pet Health and Safety
- Issue E: Impacts on Use of Public Lands
- Issue F: Impacts on Other Sociocultural Issues

3.1 Impacts on Populations of Target Species

3.1.1 Alternative 1 – Proposed Action/No Action Alternative—Continue WS-Colorado PDM Program

The methods used by WS-Colorado to take target predators under the current program were discussed in Chapter 2. They are the same as those that have been used in recent years and discussed in the prior EA (WS 2017a). The methods used in each damage situation depend on the species causing the damage and other factors including location (*e.g.*, public versus private lands), weather, and time of year. The methods include frightening devices, foothold traps, cage traps, neck and foot snares, shooting, calling and shooting, aerial PDM, net guns, hunting dogs, M-44s (sodium cyanide ejectors), and denning (gas cartridge). Other methods may be used, but most of these would be incorporated by the resource owner.

During FY12-16, WS-Colorado conducted PDM on agreements which comprised an annual average of 4,398 mi^2, which is 4.2% of the 104,185 mi^2 in the State of Colorado. Additionally, PDM is typically only conducted by WS-Colorado on a small proportion of any property under agreement. WS in New Mexico (WS 1997) compared the specific pasture areas on which PDM lethal methods were expected to be used to the total area under WS agreements in the Albuquerque WS District. That analysis indicated the actual area subjected to WS PDM was less than 1/5 of the total area under agreement. For example, an entire property under a WS agreement may contain 3,200 acres, but the WS Specialist may determine that there is only a need to work in a particular area that covers 640 acres, because that is where the damage is occurring. We believe that the scenario is similar in Colorado; WS-Colorado actually conducts PDM on approximately 1/5 of lands under agreement. Using this calculation, less than 0.8% of the land area of Colorado was exposed to WS-Colorado PDM in an average year during FY12-16 (range: 0.72%-0.96%). WS PDM actions only occur on a small fraction of the land area in the state and therefore only have the potential to impact a small proportion of the statewide predator populations. Moreover, WS-Colorado does not work continuously throughout the year on these properties, and generally spends only a few hours or days on any specific property during the year resolving predator damage problems.

WS-Colorado conducts PDM for 12 mammalian predator species in Colorado (Table 3-1), but could target any of the 20 native or 3 introduced mammalian predator species in Colorado if requested to alleviate damage. The primary target species taken yearly in Colorado are coyote, raccoon, red fox, striped skunk, black bear, mountain lion, feral cat, badger, and to a lesser extent, Virginia opossum, bobcat, swift fox, and feral dog. These latter three species are taken by WS-Colorado only occasionally. All target predators taken during FY12-16 by WS-Colorado are presented in Table 3-1. On average, coyotes represented 84% of this take, raccoons 4%, red fox 4%, striped skunks 4%, black bears 3%, mountain lions 0.4%, and all others 0.7%.

Table 3-1. All target predators killed by WS-Colorado for predator damage management during federal Fiscal Years 2012-16.

Species	FY12	FY13	FY14	FY15	FY16	Average
Coyote	1,781	2,026	1,598	1,881	2,535	1,964
Raccoon	110	126	92	115	71	103
Red Fox	95	79	34	131	107	89
Striped Skunk	112	110	30	74	94	84
Black Bear	84	44	101	91	42	72
Mountain Lion	10	17	7	5	13	10
Feral Cat	14	11	3	0	7	7
American Badger	14	6	1	3	2	5
Virginia Opossum	0	1	0	2	5	2
Bobcat	4	0	1	0	1	1
Swift Fox	0	0	4	0	2	1
Feral Dog	1	0	0	0	0	0
Total	2,225	2,420	1,871	2,302	2,879	2,339

Data includes all target and non-target take by WS-Colorado.

Table 3-2 summarizes the average WS-Colorado take and cumulative take of each predator species analyzed. We will use these numbers to assess potential impacts to these species from PDM, including cumulative impacts. In order to do this, population estimates are necessary. Unfortunately, for most of these target predator species, the statewide population is not known. Herein, we will use the best available science to make conservative estimates of these species' populations based on their density and frequency throughout Colorado. These estimates, as well as potential impacts to each species are analyzed in more depth in the following sections. Table 3-2 summarizes these analyses.

Table 3-2. Overview of impact analyses of predator species targeted by WS-Colorado for predator damage management during federal Fiscal Year 2012-16.

Species	WS Take[a]	Sportsman Harvest[b]	Cumulative Take[c]	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate[d]	Significant Impact?
Coyote	1,964	45,329	47,338	146,000	1.35%	32.42%	60%	No
Raccoon	103	2,845	2,948	135,000	0.08%	2.18%	49%	No
Red Fox	89	1,287	1,376	94,000	0.09%	1.46%	64%	No
Striped Skunk	84	1,254	1,338	208,000	0.04%	0.64%	11%	No
Black Bear	72	1,125	1,197	17,000	0.42%	7.04%	14%	No
Mountain Lion	10	427	437	4,850	0.21%	9.01%	11%	No
Feral Cat	7	N/A	7	ND	ND	ND	N/A	No
American Badger	5	253	258	52,000	0.01%	0.50%	10%	No
Virginia Opossum	2	45	47	9,500	0.02%	0.49%	10%	No
Bobcat	1	1,683	1,729	10,000	0.01%	17.29%	17%	No
Swift Fox	1	333	334	9,100	0.01%	3.67%	15%	No
Feral Dog	-	N/A	ND	ND	ND	ND	N/A	No
Feral Domestic Ferret	-	N/A	0	ND	ND	ND	N/A	No
Gray Fox	-	697	697	36,000	-	1.94%	25%	No
W. Spotted Skunk	-	-	-	26,500	-	-	10%	No
Long-tailed Weasel	-	-	-	104,000	-	-	10%	No
Short-tailed Weasel	-	-	-	40,000	-	-	50%	No
American Marten	-	327	327	20,000	-	1.64%	12%	No
American Mink	-	8	8	90,000	-	0.01%	30%	No
Ringtail	-	28	28	12,500	-	0.22%	10%	No

[a]WS Take is average annual lethal take, including nontarget take, during FY12-16.

[b]Sportsman harvest data from CPW (2016).

[c]for some species (e.g., coyote, bobcat), cumulative take includes more than sportsman harvest and WS take. See species analyses.

[d]Long-term sustainable harvest rates not available for many species, so we used the lowest rate for any species in this analysis (10%) as conservative estimates for those species.

ND = not determined (data not avaliable); N/A = not applicable

3.1.1.1 Impact on Coyote Populations:

Coyotes (*Canis latrans*) were once found only in western States, but have expanded their range in recent history to much of North America as a result of changes in habitat, loss of wolves, and possible introductions into other parts of the country where they were previously not found (Bekoff and Wells 1982, Voigt and Berg 1999). They are ubiquitous and abundant in Colorado with lowest densities in dense coniferous forests (Armstrong *et al.* 2011). They have consistently been the species most harvested by sportsmen in Colorado averaging almost 40,000 annually from 2007 to 2013 (CPW 2016a). Coyotes are ecological generalists; they can adapt to many different environments and diets. Even among ecological generalists, many wildlife biologists characterize coyotes as having a unique resilience to change. In fact, the habitat changes that have occurred over the last two hundred years have generally favored the species.

To understand the impacts of PDM and other take on the coyote population, it is useful to know the population size. However, determinations of coyote densities are frequently limited to educated guesses (Knowlton 1972). This is likely due in part to the fact that coyotes are highly mobile animals with home ranges (territories) that vary seasonally as well as with the sex, age, and breeding status of the animal (Todd and Keith 1976, Althoff 1978, Pyrah 1984). Coyote home ranges have been documented to vary from 2.0 mi^2 to 21.3 mi^2 (Andelt and Gipson 1979, Gese *et al.* 1988). Some researchers have also observed a wide overlap among coyote home ranges; so much overlap in fact, that they did not consider coyotes to be territorial (Ozoga and Harger 1966, Edwards 1975, and Danner 1976). Moreover, coyote pack size varies considerably. Each coyote territory may have several nonbreeding helpers at the den during whelping; thus each defended coyote territory may have more than just a pair of coyotes (Allen *et al.* 1987, Bekoff and Wells 1982). Messier and Barrette (1982) reported that from November through April, 35% of the coyotes were in groups of three to five animals. Gese *et al.* (1988) reported that 40% of coyotes were found in groups of two, whereas 53% were found in groups of three-to-five. Food density can also affect coyote density and home range. For example, a positive relationship was established between coyote densities in mid-late winter and the availability of dead livestock (Roy and Dorrance 1985).

Such variations in food concentrations, pack size, and home range can influence coyote densities, and complicate efforts to estimate abundance (Danner and Smith 1980). As such, statewide coyote population estimates for Colorado are not available from CPW or other researchers. However, a conservative estimate can be made using information on coyote biology and population dynamics in the western United States.

Many authors have estimated coyote populations throughout the West and elsewhere, and coyote density has been shown to vary depending on the time of year, food abundance, and habitat (Andelt 1985, Pyrah 1984, Camenzind 1978, Knowlton 1972, Clark 1972, USFWS 1979, Gese *et al.* 1989, Hein and Andelt 1995, Fedriani *et al.* 2001, Knowlton *et al.* 1985, Voigt and Berg 1999, McClure *et al.* 1996). Coyote densities have been reported from 0.4/mi^2 to 11.9/mi^2 (Pyrah 1984, Knowlton 1972, Fedriani *et al.* 2001, McClure *et al.* 1996). The lowest reported densities (0.4/mi2) are for spring breeding populations, when the annual population cycle is lowest, after dispersal of young, and most or all natural and anthropogenic mortality has occurred; this is often referred to as the pre-whelping density. Those same coyote populations numbered 2.5-times higher (1.0/mi2) in the summer, post-whelping (Pyrah 1984). Similar numbers were reported in Kansas by Gier (1968), where pre-whelping and post-whelping densities were estimated at 0.7/mi2 and 2.0/mi2, respectively. This represents a 2.9-fold increase.

Some of the more recent coyote density estimates have shown dramatic differences due to the availability of anthropogenic food sources, including livestock and fruit (McClure *et al.* 1996, Fedriani *et al.* 2001, others cited therein). This may explain some of the wide variation in reported coyote densities in the western United States. For example, Fedriani *et al.* (2001)

studied three sites: one with low human impact, one with high human impact, and one with intermediate human impact. They found the lowest coyote densities in the low-human-impact site (0.8-1.0/mi2), and highest densities at the high-human-impact site (6.2-7.8/mi2). The intermediate-human-impact site had intermediate coyote density (4.1-5.2.mi2). The high-human-impact site had some of the highest densities reported for coyotes, exceeded only by a study in suburban Arizona where human impacts were also high (McClure *et al.* 1996).

This may seem counter-intuitive at first, because human impacts have been shown to negatively affect many wildlife species. However, coyotes are ecological generalists, which frequently benefit from human impact due to their ability to adapt to anthropogenic sources of food and shelter (Moore and Parker 1992, Santana and Armstrong 2017).

A few studies have estimated coyote density in Colorado, but none have attempted to assess the statewide population. Rather, these studies, like most others, have focused on small areas, where the researchers could determine the population with some degree of certainty. At a location with low human impact, Gese *et al.* (1989) estimated the coyote density at 0.75/mi2 (range 0.36-1.2/mi2). In a more human-influenced location, Hein and Andelt (1995) estimated the coyote density at 1.84/mi2.

Federally-owned lands comprise 35.9% of the State of Colorado (Vincent *et al.* 2017) and the Colorado State Land Board owns 4.2% of the lands in Colorado (Colorado State Land Board 2017). These lands can be considered to have low human impact. This assumption is very conservative, because a significant portion of these lands are leased for livestock grazing, and most State Land Board lands are small acreages checker-boarded throughout Colorado, both of which result in human influence. Farmland comprises 48% of the State of Colorado (Farmland Information Center 2017). These lands can be considered to have intermediate or high human impact, as described by Fedriani *et al.* (2001) (and others cited therein). Most of the other 11.9% of the State of Colorado is urban and suburban land, or other private lands inhabited by humans. These lands can also be considered to have moderate or high human impact. This analysis does not factor for other State-owned lands, local-government-owned lands, and tribal lands; however, these lands comprise less than 4% of the State of Colorado, and most have some level of impact by humans.

If we use the Hein and Andelt (1995) estimate of 1.84/mi2 for the proportion of lands in Colorado with more human influence (farms, urban, and suburban; 59.9%), and the Gese *et al.* (1989) estimate of 0.75/mi2 for the proportion of lands in Colorado with less human influence (federal and State Land Board lands, 40.1%), we can conservatively estimate the coyote population in Colorado at 145,902 individuals. This corresponds to a statewide density of 1.4 coyotes/mi2, which is on the low end of the reported densities (0.4-11.9/mi2). In fact, both of the estimates reported from Colorado are on the low end of the reported densities.

In one of the most widespread studies undertaken on predator densities, scent-post surveys were used as an index of coyote populations in 19 western states from 1972 to 1977 (summarized in Knowlton and Stoddart 1983). Colorado ranked intermediate among these states; the Colorado index was 105 coyote visits/1,000 scent posts, within the range of 29 (Minnesota) to 172 (Nebraska) coyote visits/1,000 scent posts. These extensive data, gathered over almost a decade, support the notion the Colorado coyote population is intermediate among western states. The observations of WS-Colorado Specialists that conduct PDM in Colorado generally concur that coyote numbers in Colorado are relatively moderate with some areas of very high density.

Considering the published range from 0.4/mi^2 to 11.9/mi^2, we believe that a density of 1.4/mi^2 is a conservative estimate for Colorado. Colorado encompasses 104,000 mi^2, and the coyote is found throughout the State. Thus, a conservative estimate of the coyote population in Colorado, is approximately 146,000 coyotes.

In Colorado, coyotes are managed by CPW as a furbearer and can be taken year-round, though a limited season could be established at some time in the future. Whereas they are technically considered carnivores (Order Carnivora), coyotes enjoy an omnivorous diet, and will readily eat crops such as cantaloupe and watermelons, which are major crops in some areas of southeastern Colorado. Coyote predation on wildlife species in Colorado, such as sandhill cranes, least terns, mule deer, and pronghorn (antelope) has also created concern in some areas, but no value is presented in this EA for such losses.

A population model developed by Pitt *et al.* (2001) assessed the impact of removing a set proportion of the coyote population in one year and then allowing the population to recover (referred to as "pulse removal"). In the model, all populations recovered within 1 year when <60% of the population was removed. The population recovered within 5 years when 60-90% of the population was removed. The authors stated that actual coyote populations would recover even more quickly than the model indicated, because the model made several conservative assumptions: (1) coyote territories were retained even at low densities, (2) animals would not move out of their territories to mate, (3) no animals moved in from surrounding areas (no immigration), and (4) natural mortality rates were not reduced at low population densities. Assumptions like these are generally necessary in order to simplify population models, but in this case, each assumption removes a biological function which would serve to help the population recover more quickly.

Pitt *et al.* (2001) also evaluated the impact of removing a set proportion of the population every year for 50 years ("sustained removal"). When the removal rate was <60% of the population, the population size was the same as for an unexploited population. However, a shift in population structure was noted. For example, the population with 50% removal had fewer transient animals, a younger age structure, and higher reproduction. Sustained removal rates of >70% of the population resulted in removal of the entire population after 7 years in the model, but the authors acknowledged that annual removal of 70% of the population would become increasingly difficult at low densities.

Because of the model limitations described above, natural populations are probably able to withstand greater levels of sustained removal than their model indicated as well. An earlier model developed by Connolly and Longhurst (1975), and revisited by Connolly (1995), indicated that coyote populations could withstand an annual removal of up to 70% of their numbers and still maintain a viable population. For this EA, we will use the lowest reported long-term sustainable harvest rate (60%) as a conservative estimate. This means that the coyote population will not be negatively affected if less than 60% of the population is removed annually, and that any rate below 60% can be continued in perpetuity with no deleterious effect. Harvest rates above 70% would also not affect the statewide population, as long as they are not continued long-term.

Direct Impacts: During FY12-16, coyotes were responsible for 46% of the livestock losses recorded by WS-Colorado, and 37% of the value of all losses due to predators. The value of losses from coyotes averaged $110,748 per year (Table 1-4). They are therefore a major focus of WS-Colorado PDM efforts, and they make up the largest percentage of the WS-Colorado predator take (84%). The resources that WS-Colorado protects from coyote depredation include: livestock (primarily lambs and calves), crops, property (*e.g.*, drip irrigation lines and pets), human health and safety (*e.g.*, prevention of attacks on humans), and natural resources (*e.g.*, protection of threatened piping plovers). The coyote population in Colorado was estimated to be 146,000. This estimate will be used to determine impacts (Table 3-3).

Table 3-3. Overview of coyote impact analysis.

Year	WS Take	Sportsman Harvest[a]	Other Take[b]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	1,781	64,294	46	66,121	146,000	1.2%	45%	60%	No
FY 2013	2,026	41,337	46	43,409	146,000	1.4%	30%	60%	No
FY 2014	1,598	45,329	62	46,989	146,000	1.1%	32%	60%	No
FY 2015	1,881	28,529	39	30,449	146,000	1.3%	21%	60%	No
FY 2016	2,535	42,513	33	45,081	146,000	1.7%	31%	60%	No
Average	**1,964**	**45,329**	**45**	**47,338**	**146,000**	**1.3%**	**32%**	**60%**	**No**

[a]Average sportsman harvest used for FY14 because no annual estimate was available. Average is from the five most recent years with available data (2010-11, 2011-12, 2012-13, 2014-15, 2015-16). Data from CPW 2016.

[b]Other take includes aerial shooting by private individuals.

WS-Colorado only takes coyotes where they cause conflict with human endeavors; thus, WS-Colorado take is limited to more human-influenced environments which have been shown to have higher coyote densities, as discussed above (Fedriani *et al.* 2001). Moreover, coyote populations in agricultural areas, where most coyotes are taken by WS-Colorado, have been shown to be better able to withstand harsh weather and fluctuations in prey abundance than coyote populations in more forested areas (Todd 1985). In fact, "farm carrion" was the most important winter food source in both agricultural and forested areas (Todd 1985). This information further underscores how conservative our analysis is.

WS-Colorado took an average of 1,964 coyotes annually during FY12-16, with a range of 1,598 to 2,535. These numbers represent 1.1% to 1.7% of the estimated coyote population in Colorado. Coyote take by WS-Colorado often varies considerably from year to year, and we anticipate such variation in future years. Under Alternative 1, we anticipate annual take of coyotes by WS-Colorado to be less than 3,200, accounting for annual variability. This take represents 2.2% of the estimated population, which studies estimate can withstand annual take of at least 60%. Based on this information, PDM by WS-Colorado would have minor short-term impacts on coyotes locally, and no impact on the overall coyote population in Colorado. WS-Colorado coyote take may cause a temporary decrease in localized populations where more frequent PDM is performed, but other coyotes will re-occupy these areas; thus, there will be no long-term effects in these locations, and no effect on the statewide population. Short-term decreases in local populations are often the goal of PDM, as discussed previously.

Annual mortality in coyote populations is known to range from 19-100% with 40-60% mortality most common. In an EIS on mammalian PDM (USFWS 1979), studies of coyote survival rates were analyzed and the following conclusions were made:

- Typical annual survival rates are only 45-65% for adult coyotes.
- High mortality rates have also been shown in four telemetry studies involving 437 coyotes that were older than 5 months of age; 47% of the marked animals are known to have died.
- Mortality rates even among "unexploited" coyote populations were reported to be

between 38-56%.

- Most coyote populations, even those that are not subjected to control activities, are dynamic.
- In studies, where reported coyote mortality was investigated, only 14 of 326 recorded mortalities were due to WS activities.

Dispersal of "surplus" young coyotes is the main factor that keeps coyote populations distributed throughout their habitat. Such dispersal of subdominant animals removes surplus animals from higher density areas and repopulates areas where population reductions have occurred. Two studies (Connolly *et al.* 1976, Gese and Grothe 1995) investigated the predatory behavior and social hierarchy of coyotes, and determined that the more dominant (alpha) animals were the ones that initiated and killed most of the prey items. Connolly *et al.* (1976) concluded that the inclination of individuals to attack seemed related to their age and relationships with conspecifics. The coyotes that attacked sheep most frequently were 2-year old males and females paired with these males. Gese and Grothe (1995) found that the dominant pair was involved in the vast majority of predation attempts. The alpha male was the main aggressor in all successful kills, even when the other family members were present. Thus, it would appear that removal of local established territorial coyotes actually removes the individuals that are most likely to kill livestock and can result in the immigration of young coyotes that are less likely to kill livestock.

Conner (1995) suggested that some WS employees are not very successful in removing dominant territorial coyotes. However, the study involved coyotes which had already been captured once for radio telemetry purposes and were thus substantially more difficult to catch (G. E. Connolly 1997, pers. comm.). In a review of the study and its conclusions, R. Timm (Superintendent and Extension Wildlife Specialist, Hopland Research and Extension Center; Pers. Comm. to C. Coolahan, State Director, WS-Colorado, April 15, 1996) disagreed with Conner's conclusions, citing "noise" (*i.e.*, confounding factors or unaccounted variables) in the data, and expressed the opinion that WS efforts "usually reduced the amount of coyote-caused loss which we would have otherwise experienced on our research sheep flock." In general, experienced WS personnel are comparatively proficient at removing dominant pairs.

In a study in New Mexico, Windberg *et al.* (1997) found no statistically significant difference between territorial and transient coyotes in the proportion of each type that consumed Angora goats. They concluded that management measures to protect livestock during periods of exposure of highly vulnerable kid goats or lambs may be best directed at local coyote populations rather than at particular cohorts or individuals. Their study supports the belief that removal of coyotes from a local population without regard for age or territoriality is advisable in many situations and would not result in a worsening of predation problems for more vulnerable types of livestock such as Angora goats. Wagner and Conover (1999) found that total lamb losses declined 25% on grazing allotments in which coyotes were removed during winter aerial PDM 5-6 months ahead of summer sheep grazing, whereas total lamb losses only declined 6% on allotments without aerial PDM. Confirmed losses from coyotes declined by 7% on allotments with aerial PDM, but increased 35% on allotments receiving no aerial PDM (Wagner and Conover 1999). This study provides evidence that coyote removal even several months ahead of the arrival of livestock can be effective in reducing predation losses, and that such removal does not actually result in increased losses, as has been asserted by some commenters. These data support the use of preventive PDM to prevent losses before they occur.

Indirect Impacts: Indirect impacts of WS-Colorado PDM on coyotes include the possibility of increased dispersal and increased fecundity, which may lead to a younger age structure in local coyote populations (Jackson 2014). Such indirect impacts from WS-Colorado PDM would be limited to those areas where WS-Colorado conducts PDM, which is only 0.8% of the State. Such localized impacts would be temporary, and would likely have no impact on statewide populations due to the limited area in which WS-Colorado conducts PDM. These are also natural responses to other environmental factors. WS-Colorado has no reason to believe that such changes would result in any negative impact to the statewide coyote population, or any long-term impact to local coyote populations. Under Alternative 1 we anticipate that indirect impacts would be negligibly low, and that there would be no indirect impact on the statewide coyote population.

Cumulative Impacts: Sportsman harvest is the largest category of take, and it can be estimated. Coyote removal by private individuals for PDM also occurs, and all such known data is included in the "Other Take" category (Table 3-3). Additional PDM take is likely to occur, but there are no data available to estimate this take, and it is expected to be low compared to all other methods of take. We have included all of the known take which we are aware of that can be estimated or quantified, and we believe that this reflects the majority of all actual take.

Sportsman harvest is estimated in most years by CPW based on surveys. We used 2011-12 season data for FY12, and so forth, because these timeframes best match our FYs. No estimate was available for FY14, so we used the average for the analysis of that year. Sportsman harvest estimates for the FY12-16 timeframe ranged from 28,529 to 64,294. We used the estimates from the five most recent years with available data to calculate the average sportsman harvest during FY12-16. Those estimates are from the 2010-11, 2011-12, 2012-13, 2014-15, and 2015-16 hunting/trapping seasons, and averaged 45,329 coyotes. These estimates are statistically derived based on sportsman surveys, and CPW has noted the inherent error and unreliability of these estimates (CPW 2016a); however, they are the only data available to estimate sportsman harvest. One example of such error is the 2011-12 coyote harvest estimate, which is 44% higher than the surrounding years. The same survey produced an estimate of the number of coyote hunters which was 54% higher than the surrounding years, and an estimate of days hunted (for coyotes) which was 99% higher than the surrounding years. We believe that this is an overestimate of the true sportsman harvest in that year, which results in an overestimate of the cumulative take analyzed herein. Still, these are the only data available, and in the interest of transparency, we report the estimates published by CPW (2016a).

The "Other Take" in Table 3-3 includes aerial PDM by private individuals as reported to CDA (W. East, email, 06 October 2017 and 25 February 2015). "Other Take" ranged from 33 to 62, with an average of 45 coyotes.

On average, sportsmen took 45,329 coyotes per year during FY12-16, representing 29% of the coyote population. Using these numbers, cumulative take averaged 47,329 coyotes per year during FY12-16, with a high of 66,121 in FY12. This represents an average harvest of 30% of the state's coyote population, with a high of 42% in FY12. These numbers are all well below the 60% sustainable harvest threshold.

Even with possible under-reporting of "Other Harvest" (*e.g.*, PDM by other individuals), the coyote population would not be negatively affected unless this additional harvest totaled more than 45,000 coyotes each year, bringing the cumulative total above 62,500 (60% of the estimated population). This level of PDM take by other individuals is extremely unlikely, due to the level of effort which would be required. Moreover, occasional years with take above the

60% threshold would also not impact the coyote population, as long as such take levels did not continue long-term.

We also considered the possibility that cumulative coyote take might result in a younger coyote age structure statewide, and that coyote take by WS-Colorado might contribute to such an impact. However, the locations where sportsmen harvest coyotes are generally spatially separated from those areas where WS-Colorado conducts PDM, because coyote abundance is generally lower where WS-Colorado conducts PDM. Most WS-Colorado PDM (53% by area, 70% by number of visits) is conducted on private lands.

Under Alternative 1, we do not anticipate any major changes in the amount of cumulative coyote take in Colorado, except that future sportsman harvest estimates will likely be much lower than the 2011-12 estimate, which we believe to be an over-estimate. Thus, we anticipate low cumulative impact on local coyote populations in the short-term, and no impact on the overall Colorado coyote population (Table 3-3). This is due, at least in part, to the ability of coyotes to rapidly occupy vacant territories where coyotes have been removed during PDM (Windberg and Knowlton 1988). Whereas removing coyotes from localized areas at the appropriate time can protect vulnerable livestock, immigration of coyotes from the surrounding area quickly replaces the animals removed (Stoddart 1984). Connolly (1978) further noted that coyotes have survived and even thrived in spite of early 20th century efforts to exterminate them.

Cumulative take of coyotes is also largely limited to human-influenced environments, which have been shown to have higher coyote densities, as discussed above (Fedriani *et al.* 2001). Thus, the magnitude of cumulative take in Colorado is even less likely to impact statewide coyote populations, because it is focused where the populations are highest.

Under Alternative 1, there would be no significant impact on the coyote population. This determination is consistent with the GAO (1990) assessment that WS's PDM program nationwide has not threatened statewide predator populations, including coyotes, particularly in the western United States where such PDM programs were most prevalent.

Coyote populations are considered to be increasing throughout their range, and they are listed as a species of "least concern" according to the International Union for Conservation of Nature (IUCN 2017).

3.1.1.2 Impact on Northern Raccoon Populations:

Northern raccoons (*Procyon lotor*) are abundant throughout North America, except northern Canada. They are typically associated with riparian and forested habitats, but have become increasingly common in urban areas (Armstrong *et al.* 2011). Raccoons are one of the most omnivorous animals, feeding on carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, a wide variety of grains, various fruits, other plant materials, and most or all foods prepared for human or animal consumption (Sanderson 1999). They are found throughout Colorado, except areas above 10,000 feet elevation, occupying approximately 90% of the state. They are most abundant in suburban and urban areas, along waterways, and in forests in the less arid portions of Colorado; they sometimes can be found a long distance from water in a variety of habitats including desert scrub (Armstrong *et al.* 2011).

Since the 1940s, raccoon populations throughout the U.S. have increased, likely as a result of adapting well to man-made habitats; like coyotes and red fox, raccoons are ecological generalists. Raccoon densities vary considerably, depending on habitat suitability. Twichell and Dill (1949) reported one of the highest densities where 100 raccoons were removed from a winter tree den area on 101 acres of a waterfowl refuge in Missouri (a local density of

634/mi²). Other studies have found raccoon densities that ranged from 1.3/mi² to 80/mi² (Yeager and Rennels 1943, Urban 1970, Sonenshine and Winslow 1972, Hoffman and Gottschang 1977, Fritzell 1978, Rivest and Bergerson 1981, and Armstrong *et al.* 2011). Densities in Colorado are expected to be on the lower end of this range: 1.3-8.3/mi², except for urban areas, where densities will be higher (Armstrong *et al.* 2011). Colorado probably has some ideal habitat areas with large numbers of raccoons (urban and suburban areas, and riparian areas), but their density is probably low statewide because ideal habitat is sparse.

Table 3-4. Overview of raccoon impact analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	110	2,845	2,955	135,000	0.08%	2.2%	49%	No
FY 2013	126	2,845	2,971	135,000	0.09%	2.2%	49%	No
FY 2014	92	2,845	2,937	135,000	0.07%	2.2%	49%	No
FY 2015	115	2,845	2,960	135,000	0.09%	2.2%	49%	No
FY 2016	71	2,845	2,916	135,000	0.05%	2.2%	49%	No
Average	**103**	**2,845**	**2,948**	**135,000**	**0.08%**	**2.2%**	**49%**	**No**

[a]WS Take is all lethal take, including nontarget take.

[b]Sportsman Harvest estimates not available during FY12-16, so the average of the five most recent estimates is used. This includes 2001-02, 2002-03, 2003-04, 2004-05, and 2009-10 seasons. Data from CPW 2016.

We believe that 135,000 raccoons is a conservative population estimate for Colorado, using the lowest density figure (1.3/mi²), and considering that they occupy approximately 90% of the state. Sportsman harvest for raccoons has averaged 2,845 annually in recent years. This is much lower than historic hunter harvest, which averaged 8,037 annually (Table 3-4; CPW 2016a).

Raccoons are managed as a furbearer in Colorado, and CPW is responsible for oversight of raccoon management. CDA has authority for damage to agricultural resources.

WS-Colorado recorded an average of $10,767 in losses annually during FY12-16. Raccoons caused damage to property, crops, and livestock, and threatened human health & safety.

Sanderson (1999) reported sustainable harvest rates of 49%, 53%, and 59% for raccoon populations with low, medium, and high fecundity, respectively. For this analysis, we will use the lowest reported harvest rate (49%) as a conservative estimate.

Direct Impacts: WS-Colorado took an average of 103 raccoons per year during FY12-16, with a range of 71 to 126 (Table 3-4). This corresponds to an average of 0.08%, with a maximum of 0.09% of the estimated raccoon population in Colorado. Under Alternative 1, we anticipate that WS-Colorado would take no more than 200 raccoons. This corresponds to less than 0.15% of the estimated statewide raccoon population, which is well below the 49% sustainable harvest rate. Local natural populations of raccoons would not be affected because WS-Colorado takes very few raccoons outside of urban and suburban environments. Within urban environments, local striped raccoon populations may be temporarily decreased under this alternative, but these locations generally harbor artificially dense raccoon populations due to anthropogenic sources of food and shelter (Armstrong *et al.* 2011). Moreover, immigration will likely counteract this effect, and long-term populations are not likely to be affected even within these urban areas. Under Alternative 1, we anticipate that WS-Colorado PDM would have a negligible impact on natural raccoon populations locally. We anticipate no impact to statewide raccoon populations in Colorado under Alternative 1.

Indirect Impacts: Northern raccoon take by WS-Colorado is largely limited to urban areas, so the potential indirect impacts are limited to those areas. In urban areas, raccoon populations are already greatly influenced by humans, who (generally unwittingly) provide them with food and shelter, which artificially increases the biological carrying capacity (Armstrong *et al.* 2011). It is possible that within these artificially high urban populations, WS-Colorado PDM might alter the rate of immigration, which might affect the age structure. Because these urban populations are already so dramatically influenced by humans, we do not consider these impacts to be significant to the natural environment. For example, these urban populations are already affected by high mortality due to vehicle collision, so the populations likely already have high immigration, high fecundity, and a young age structure. We are not aware of any other significant indirect impacts due to PDM conducted by WS-Colorado which might negatively affect raccoons.

Cumulative Impacts: Sportsman harvest was not estimated by CPW during FY12-16, so we used the five most recent estimates available to calculate an average for the purpose of this analysis. Sportsman harvest was estimated at 3,703, 2,777, 2,153, 293, and 5,299 in 2001-02, 2002-03, 2003-04, 2004-05, and 2009-10 respectively (CPW 2016a). The average sportsman harvest was 2,845, and cumulative take averaged 2,948, with a maximum of 2,971 (Table 3-4). Cumulative take was 2.2% of the population during FY12-16, which is well below the long-term sustainable harvest rate of 49%. Under Alternative 1, we anticipate similar levels of take, with similar fluctuations in take by WS-Colorado. We anticipate this level of take to have a negligible impact on raccoons locally, and no impact on the statewide raccoon populations in Colorado.

Raccoon populations are considered to be increasing throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.3 Impact on Red Fox Populations:

Red fox (*Vulpes vulpes*) are the most common and well-known species in the genus *Vulpes*, and are the most widely distributed nonspecific predators in the world (Voigt 1999). Red fox are found throughout much of North America and are common in varying abundance throughout Colorado. In the early 1900s, red foxes were not as abundant in Colorado, and generally only found in the mountainous areas. But foxes have expanded their range throughout Colorado, with lowest numbers in the southeastern quarter of the plains (Armstrong *et al.* 2011). Their range has expanded as a result of red fox introductions from abandoned fur farms and probable expansion from the east into agricultural areas. Like coyotes, red foxes are ecological generalists, and therefore very adaptable to new environments. The red fox has a high reproductive rate, a dispersal capacity similar to coyotes, and can withstand high mortality within the population (Allen and Sargeant 1993, Voigt 1999, Voigt and MacDonald 1984, Harris 1979, Pils and Martin 1978, Storm *et al.* 1976, Andrews *et al.* 1973, and Phillips and Mech 1970). Red fox eat mostly small mammals, birds, insects and mast, but will also take small livestock and poultry. Of the foxes in Colorado, red fox cause the most damage, often involving livestock. Voigt and Earle (1983) and Gese *et al.* (1996) found that red foxes avoided coyotes but coexisted in the same area and habitats.

Red fox have a home range of 1-2 mi^2, but often travel outside of that home range. Storm *et al.* (1976) found that 95% of the females (43.6% were less than 1 year old) bred successfully in a population in Illinois and Iowa. Rowlands and Parkes (1935) and Creed (1960) reported that male red fox breed in their first year. Litter sizes averaged about 4.7 among 13 research studies, with litters up to 17 offspring reported (Storm *et al.* 1976, Voigt 1999). Ables (1969) and Sheldon (1950) reported that more than one female was observed at the den and suggested that red fox have "helpers" at the den, a phenomenon observed in coyotes and other canids.

Red fox densities have been shown to range from 0.3/mi^2 in the alpine tundra to 80/mi^2 in urban areas with abundant food (Voigt 1999, Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986). Much of the available habitat in Colorado, including agricultural and suburban habitats, would support densities of red fox on the higher end of this scale; very little of the State is low-density habitat such as alpine tundra (Voigt 1999). An average density for red foxes in Colorado might be conservatively estimated at 1/mi^2. Considering that red fox occupy all of Colorado, and that Colorado encompasses 104,000 mi^2, we estimate the population of red foxes in Colorado to be approximately 104,000 red fox, with highest densities in suburban and agricultural areas.

CPW is responsible for the management of foxes in Colorado, which are classified as furbearers; however, CDA is responsible for fox damage to agriculture. Foxes are regarded as nuisance predators in many regions, preying on wildlife and livestock, and have become known in many areas of the world as carriers of diseases (Ables 1969, Andrews *et al.* 1973, Tabel *et al.* 1974, Tullar *et al.* 1976, Pils and Martin 1978, Sargeant 1978, Allen and Sargeant 1993, Voigt 1999). WS-Colorado recorded an annual average of $4,025 in damages due to red foxes in FY12-16 (Table 1-4). These damages were mostly due to depredation of livestock, including lambs and poultry (Table 1-5).

Red fox are harvested by sportsmen in higher numbers than most predator species (except for coyotes), averaging 1,287 annually in recent years (Table 3-5, CPW 2016a).

Long-term sustainable harvest rates for red have been reported at 64-76% (Layne & McKeon 1956) and 70% (Davis 1974) have been reported. We will use the more conservative rate of 64% as the sustainable harvest threshold, below which fox populations would not be expected to be impacted.

<u>Direct Impacts</u>: WS-Colorado took an average of 89 red fox in Colorado, 3.8% of the average WS-Colorado predator take during FY12-16 (Table 3-5). Red fox take by WS-Colorado ranged from 34 to 131. This level of take represents a maximum of 0.13% of the red fox population in Colorado, with an average of less than 0.1%. Red fox take by WS-Colorado has varied considerably over the years (FY02-16; Figure 3-1). Under Alternative 1, we anticipate that such fluctuations will continue, and that WS-Colorado will take less than 200 red fox. This represents 0.2% of the estimated red fox population, which studies estimate can withstand annual take of 65%. Under Alternative 1, we anticipate a negligible impact on red fox locally, and no impact on statewide red fox populations in Colorado. Red fox take by WS-Colorado may result in a temporary decrease in localized

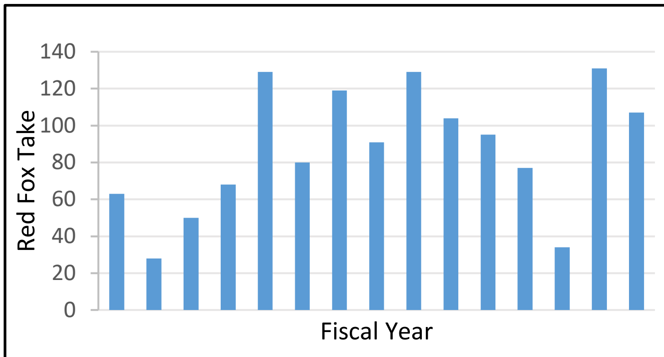


Figure 3-1. WS-Colorado take of Red Fox during federal Fiscal Year 2002-2016, showing the variation among the years.

populations where heavy PDM is performed, but other red foxes will re-occupy these areas, so the effect will be limited to the short-term. In the long-term, the impact on local populations would be negligible. Moreover, short-term decreases in local populations are often the goal of PDM, as discussed previously.

Indirect Impacts: Coyotes comprise 84% of WS-Colorado's average annual predator take, and red fox comprise only 4%. Because coyotes and red foxes compete for habitat, the disparity in take between the species may result in local decreases in interspecific competition. This may result in increases in local red fox populations. However, coyotes are likely to re-occupy these locations due to immigration, so this effect is unlikely. Regional and statewide red fox populations are not likely to be affected. This is discussed in Section 3.3.1.2 under "trophic cascades". It is unlikely that this level of take would affect dispersal rates, dispersal distances, fecundity, or age-structure. We know of no other indirect impacts to red fox populations due to PDM conducted by WS-Colorado. We anticipate indirect impact to statewide red fox populations to be negligible.

Table 3-5. Overview of red fox impact analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	95	1,287	1,382	104,000	0.09%	1.3%	64%	No
FY 2013	79	1,287	1,366	104,000	0.08%	1.3%	64%	No
FY 2014	34	1,287	1,321	104,000	0.03%	1.3%	64%	No
FY 2015	131	1,287	1,418	104,000	0.13%	1.4%	64%	No
FY 2016	107	1,287	1,394	104,000	0.10%	1.3%	64%	No
Average	**89**	**1,287**	**1,376**	**104,000**	**0.09%**	**1.3%**	**64%**	**No**

[a] WS Take is all lethal take, including nontarget take.
[b] Sportsman Harvest estimates not available for any years during FY12-16, so the average of the five most recent estimates is used. This includes 2001-02, 2002-03, 2003-04, 2004-05, and 2009-10 seasons. Data from CPW 2016.

Cumulative Impacts: CPW estimated an average of 1,287 red fox taken by sportsmen (CPW 2016a), which is approximately 1.4% of the estimated red fox population in Colorado (Table 3-5). This average is based on the five most recent estimates available: 2001-02, 2002-03, 2003-04, 2004-05, and 2009-10. We used this average for each year analyzed, because no harvest estimates were available during the timeframe of the analysis in this EA (FY12-16). This number is the best estimate of sportsman harvest within this timeframe based on the available data. We are not aware of any other known harvest numbers for red fox. Using these numbers, cumulative take of red fox ranged from 1,321 to 1,418 in FY12-16, with an average of 1,376. This represents an average of 1.3% of the estimated red fox population, with a maximum take of 1.4% (Table 3-5). Under Alternative 1, we anticipate similar levels of cumulative take, with a maximum cumulative take of 3,000 red fox. This represents a maximum harvest of 2.9% of the estimated red fox population, which can withstand long-term harvest of 65%. This level of take will have a negligible impact on red fox locally, and no impact on the statewide red fox population.

As in the coyote analysis above, it is likely that some number of red fox are taken annually without our knowledge, including those taken by private citizens for PDM which are not reported. However, this number is likely to be very small compared to sportsman harvest.

Moreover, due to the large disparity between cumulative take and sustainable take, the inclusion of this take (if it were known) would not affect our analysis.

Red fox populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.4 Impact on Striped Skunk Populations:

The striped skunk (*Mephitis mephitis*) is by far the most common skunk in Colorado. It is a large skunk, up to 10 pounds, with two white stripes down its back. Striped skunks are found throughout the United States, including all of Colorado, and have expanded their range with the expansion of humans (Armstrong *et al.* 2011). Skunks are found in a variety of habitats including woodlands, grasslands, desert, and chaparral. Striped skunks are often found in association with farmland and urban areas, whereas the other skunks are mostly associated with grasslands and rocky areas, such as in canyons and outcrops (Rosatte 1999). Skunks eat a variety of food including small rodents, insects, fruits, and eggs, and sometimes kill poultry. Skunks nest in underground dens, hollow logs, under buildings and in rock crevices. During the winter they will go through periods of inactivity, especially when it is extremely cold. Skunks are typically solitary, except they may communally roost in the winter, especially the females, for warmth.

The home range of striped skunks varies spatially and temporally in order to accommodate life history requirements such as raising young, winter denning, feeding activities, and dispersal (Rosatte 1999). Home ranges have been reported between 0.11mi^2 and 1.4 mi^2 for striped skunks in rural areas (Houseknecht 1971, Storm 1972, Bjorge *et al.* 1981, Rosatte and Gunson 1984). Striped skunk densities reported in the literature range from 0.85/mi^2 to 67/mi^2 (Jones 1939, Ferris and Andrews 1967, Verts 1967, Lynch 1972, Bjorge *et al.* 1981, Rosatte *et al.* 1992). Many factors may contribute to the widely differing population densities, including habitat type, food availability, disease, season of the year, and geographic area (Storm and Tzilkowski 1982). With densities varying greatly and ideal habitat distributed throughout the state, we believe that 2/mi^2 is a conservative estimate of striped skunk density throughout Colorado. Using this density, we estimate the striped skunk population in Colorado at approximately 208,000. Sportsman harvest of striped skunks has decreased in recent years, averaging 1,254 animals annually, but historic harvest averaged 10,353 animals (CPW 2016a). Boddicker (1980) cited a 60% long-term sustainable harvest threshold for skunks, but this rate may be based only on experience, rather than on empirical data. We know of no other published sustainable harvest rate for striped skunks. Due to the uncertainty of the validity of the Boddicker (1980) harvest threshold, we will use the lowest reported threshold among all of the predator species analyzed, which is 10%, as a conservative estimate.

Skunks cause odor problems around homes; potentially transmit diseases such as rabies to humans, domestic animals, and livestock; and sometimes prey on poultry and their eggs. Skunks are primarily targeted to reduce these types of problems. The majority of damage complaints are due to skunks living and spraying in and around residences. Most of the complaints are from striped skunks. WS-Colorado recorded average annual losses of $2,020 due to striped skunks during FY12-16. This was mostly due to property damage caused by digging and foraging behavior. Most of the skunk damage reported to WS-Colorado were due to nuisance skunks, and threats to human health & safety. Many of these reflect the threat of skunk rabies, which has been spreading through Colorado in recent years. These reports do not include any dollar amount of loss, so they are not included in the annual losses above.

Direct Impacts: WS-Colorado took an average of 84 striped skunks in Colorado which is less than 0.1% of the estimated statewide striped skunk population. WS-Colorado take ranged from

30 to 112 (Table 3-6). Under Alternative 1, we anticipate that WS-Colorado would take less than 200 striped skunks in any year, which represents less than 0.1% of the statewide population. As such, we anticipate no impact on the statewide striped skunk population. Local natural populations of striped skunks would not be affected because WS-Colorado takes very few skunks outside of urban environments. Within urban environments, local striped skunk populations may be temporarily decreased under this alternative, which is generally viewed as favorable. However, immigration will likely counteract this effect, and long-term populations are not likely to be affected. Under Alternative 1, we anticipate no significant impact to statewide striped skunk populations.

Table 3-6. Overview of striped skunk impact analysis.

Year	WS Take	Sportsman Harvest[a]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	112	1,254	1,366	208,000	0.05%	0.66%	11%	No
FY 2013	110	1,254	1,364	208,000	0.05%	0.66%	11%	No
FY 2014	30	1,254	1,284	208,000	0.01%	0.62%	11%	No
FY 2015	74	1,254	1,328	208,000	0.04%	0.64%	11%	No
FY 2016	94	1,254	1,348	208,000	0.05%	0.65%	11%	No
Average	**84**	**1,254**	**1,338**	**208,000**	**0.04%**	**0.64%**	**11%**	**No**

[a]Sportsman Harvest estimates not available during FY12-16, so the average of the five most recent estimates is used. This includes 2001-02, 2002-03, 2003-04, 2004-05, and 2009-10 seasons. Data from CPW 2016.

Indirect Impacts: Striped skunk take by WS-Colorado is largely limited to urban areas, so the potential indirect impacts are limited to those areas. In urban areas, skunk populations are already greatly influenced by humans, who (generally unwittingly) provide them with food and shelter, which artificially increases the biological carrying capacity. And the cultural carrying capacity is very low due to their pungent odor. This imbalance creates conflict. It is possible that within these artificially high urban populations, WS-Colorado PDM might alter the rate of immigration, which might affect the age structure. Because these urban populations are already so dramatically influenced by humans, we do not consider these impacts to be significant to the natural environment. For example, these urban populations are already affected by high mortality due to vehicle collision, so the populations likely already have high immigration, high fecundity, and a young age structure. We are not aware of any other significant indirect impacts to striped skunks due to PDM conducted by WS-Colorado.

Cumulative Impacts: CPW did not estimate sportsman harvest of striped skunk during FY12-16. To determine a reasonable estimate of average sportsman harvest, we used the five most recent years with available data: 2001-02, 2002-03, 2003-04, 2005-05, and 2009-10. The average sportsman harvest was 1,254, with a range of 274 to 2,482 (Table 3-6; CPW 2016a). Cumulative take averaged 1,338, with a range of 1,284 to 1,366. Under Alternative 1, we anticipate that cumulative take would not exceed 3,700 striped skunks in any year, which represents less than 2% of the statewide population. Using the conservative long-term sustainable harvest threshold of 10%, this level of cumulative take would have no impact on the statewide striped skunk population.

Striped skunk populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.5 Impact on American Black Bear Populations:

American black bears (*Ursus americanus*) can be found throughout much of North America, including the Rocky Mountains. In Colorado, black bears are found throughout the western two thirds of the state where highest population densities are found in the montane forests and cottonwood canyons of western Colorado (Armstrong *et al.* 2011). Black bears can live up to 25 years (Rogers 1976), and eat a variety of foods including grass, fruits, nuts, carrion, livestock, mammals, insects, bees (especially the larva) and garbage. Bears may overturn rocks and logs looking for grubs and insects or small rodents. Research indicates they may also be a more efficient predator of large game and livestock than was previously believed (Rayl *et al.* 2015, Leblond *et al.* 2016). In Colorado, the annual mortality rate was 0.44 for cubs, 0.06 for yearlings, 0.15 for subadults, and 0.12 for adults. Female black bears reach reproductive maturity at 4-5 years (Beston 2011). Following a 7-8 month gestation period, they may have one to five cubs (Rogers 1976, Kolenosky and Strathearn 1999). Juvenile black bear annual mortality ranges between 20 and 70 percent, with orphaned cubs having the highest mortality (Kolenosky and Strathearn 1999). Natural mortality in adult black bears is approximately 10-20 percent per year (Fraser *et al.* 1982). Black bear density varies from 0.3/mi^2 to 3.4/mi^2 depending on habitat (Kolenosky and Strathearn 1999). In the southwestern U.S., black bear population densities have been documented at 1/mi^2 (LeCount 1982). In Colorado, densities are considered to be low among western states, at 0.3-0.5/mi^2 (Armstrong *et al.* 2011). The ban on use of trailing dogs, spring hunting, and baiting, may have increased the black bear population in Colorado. CPW previously estimated the bear population at 10,000-12,000 in 1991, but using new methods of estimating bear populations, the most recent CPW estimate is 17,000-20,000 (CPW 2015b). Black bears occupy about 50% of Colorado, and we believe that 17,000 is a conservative population estimate.

Black bear are protected as big game in Colorado and, as such, CPW manages their population. CDA has management authority of black bears causing damage to agriculture. WS-Colorado gives CPW information on the take of all depredating black bears to help them determine population impacts from these activities. CPW sometimes requests WS-Colorado to take black bear when the need arises due to a damage situation. WS-Colorado also receives calls regarding black bear damage from individuals, but all damage management work is coordinated with CPW. WS-Colorado recorded an annual average of $129,787 in damage due to black bears during FY12-16. Damages from black bears was mostly to livestock ($86,375 annually), but also included human health & safety ($29,300 annually), crops, bee hives, feed, and structures.

Black bears caused the highest losses due to predators among damages reported to WS-Colorado. Black bears were responsible for 43% of the predator damage recorded by WS-Colorado during FY12-16. The long-term sustainable harvest rate for black bears has been estimated at 20% (D. Koch pers. comm. 12/13/89, M. Pelton pers. comm. 12/11/89, C. Willey pers. comm. 12/11/89). Clark and Smith (1994) estimated sustainable yield of 26% for a location in Arkansas with good bear habitat, though they noted that this level may not be able to maintained indefinitely. Other published rates have been as low as 14.2-15.9% based on models (Miller 1990). For this analysis, we will use the lowest reported sustainable harvest threshold (~14%) as a conservative estimate.

Direct Impacts: WS-Colorado lethally took an average of 72 black bears per year during FY12-16, with a range of 42 (FY16) to 101 (FY14). This corresponds to an average of 0.4%, with a maximum of 0.6% of the statewide black bear population (Table 3-7). Under Alternative 1, we anticipate an increase in black bear take by WS-Colorado, up to 200 black bears, due to an increasing bear population and increasing conflicts with bears, as well as current and future research projects to assess the scope of black bear predation on native wildlife, in cooperation with CPW. This corresponds to 1.2% of the estimated statewide black bear population. This level of black bear take is well below the 14% sustainable harvest threshold, and is expected to have no impact on statewide black bear populations. Impacts to most local black bear populations would be negligible.

Table 3-7. Overview of black bear impact analysis.

Year	WS Take	Sportsman Harvest[a]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	84	1,172	1,256	17,000	0.5%	7.4%	14%	Low
FY 2013	44	1,106	1,150	17,000	0.3%	6.8%	14%	Low
FY 2014	101	1,364	1,465	17,000	0.6%	8.6%	14%	Low
FY 2015	91	1,051	1,142	17,000	0.5%	6.7%	14%	Low
FY 2016	42	933	975	17,000	0.2%	5.7%	14%	Low
Average	**72**	**1,125**	**1,198**	**17,000**	**0.4%**	**7.0%**	**14%**	**Low**

[a] Sportsman harvest data from CPW (2016).

Some local black bear populations, such as those in CPW predator study sites, might be temporarily decreased due to WS-Colorado PDM. Such decreases would be localized and temporary, and would not impact the statewide black bear population. These effects would be at the request of CPW. WS-Colorado's take of black bears is generally in response to requests by state agencies to remove problem bears. In the absence of these actions by WS-Colorado, the bears would likely still be removed either by the state agencies, agricultural producers or their agents. CPW intensively manages black bears and makes decisions about annual harvest rates.

Indirect Impacts: WS-Colorado responds to CPW's requests for assistance for urban bear damage complaints. WS-Colorado captures and euthanizes or transfers the bear(s) caught in urban areas to CPW. The use of urban areas by black bear increases in years of poor mast crops due to late spring snows or frost. Conflicts with humans increase accordingly in these years with scarce natural foods (Baruch-Mordo *et al.* 2014). CPW is placing increasing emphasis on tolerance for bears in urban areas, and securing human foods to avoid habituation of bears to human environments (Young 2017). WS-Colorado take of black bears in urban areas will likely fluctuate depending on natural food resources and requests from CPW. In rural areas, the conflict between bears and livestock producers will also likely vary annually depending on availability of natural foods. Even in poor mast years, when WS-Colorado bear take is expected to be higher, this level of take (up to 1.2% of the population) would not be expected to result in any significant impacts to black bear immigration rates, fecundity, or age structure at local or statewide population levels. We are not aware of any other indirect impacts to black bear due to WS-Colorado PDM.

Cumulative Impacts: Sportsman harvest averaged 1,125 black bears per year, with a range of 933 to 1,364. Cumulative take ranged from 975 to 1,465, with an average of 1,198 per year (CPW 2016a; Table 3-7). This corresponds to an average of 7.0%, with a maximum of 8.6% of the estimated black bear population in Colorado. Under Alternative 1, we anticipate cumulative take not to exceed 1,800 black bears in any year. This corresponds to 10.6% of the estimated black bear population in Colorado. This level of harvest is well below the 14% sustainable harvest threshold. These levels of cumulative take are expected to have a negligible impact on most local black bear populations, and no impact on the statewide population.

Some local populations might be decreased or increased due to decisions made by the State of Colorado to achieve such changes. In these cases, the impact is the desired outcome, and the participation of WS-Colorado is considered beneficial to achieving the desired outcome. PDM take by WS-Colorado might contribute to these changes whenever the decisions are based on biologically and ecologically sound principles, the goals are in accordance with the carrying capacity, and the actions would not significantly impact the black bear population statewide. These actions would be considered a benefit to the environment, and such local effects would not impact the statewide black bear population.

CPW may decide to effect a decrease in a local black bear population, if they determine that the population is above the carrying capacity. WS-Colorado's involvement in the take of black bears in such a scenario would be considered beneficial to the environment. Also, similar to mountain lion management, WS-Colorado's involvement should actually *benefit* the ability of CPW to control black bear mortality because WS-Colorado is more likely to target the correct problem bear, whereas private resource owners may not kill the target bear as reliably.

CPW has management authority over black bears in Colorado, and the decision of CPW to effect a change in the population of black bears would not necessarily be considered a significant impact, as discussed in Section 1.16.3. In order to be considered significant, the magnitude of the population change must be substantial, such as a change which results in the population being unable to sustain itself, major changes to other species populations, major alterations in ecosystem function (such as biodiversity or trophic cascades), or other significant impacts on the quality of the human environment (including increased predator damage). We do not anticipate any such impacts under Alternative 1.

We anticipate no impact to the statewide black bear population under Alternative 1.

Black bear populations are considered to be increasing throughout their range, and are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.6 Impact on Mountain Lion Populations:

Mountain lions (*Puma concolor*) have an extensive distribution across western North America including Colorado, occupying about two thirds of the state (Armstrong *et al.* 2011). This species is known by several other names including panther, puma, catamount, and cougar. Mountain lions inhabit many habitat types in Colorado from desert to alpine environments, indicating a wide range of adaptability. They are closely associated with deer, elk, and other large hoofed mammal herds because they rely on these species for food.

Female mountain lions typically breed for the first time between 22 and 29 months of age (Ashman *et al.* 1983) but initial breeding may be delayed until a territory has been established (Hornocker 1970). Mountain lions breed and give birth year round but most births occur during late spring and summer following about a 90 day gestation period (Ashman *et al.* 1983, Seidensticker *et al.* 1973, Robinette *et al.* 1961). One to six offspring per litter is possible, with an average of two or three.

Mountain lion density is primarily dependent on prey availability and intraspecific (among members of the same species) competition. Prey availability is directly related to the habitat quality of the prey species and this directly influences a mountain lion's nutritional health and reproduction and mortality rates. Studies indicate that as available prey increases, so do lion populations (Quigley and Hornocker 2010). But because mountain lions are territorial and socially intolerant animals, the rate of population increase tends to decrease as lion density increases, even though the prey availability continues to increase (Logan and Sweanor 2001, Logan and Sweanor 2010, Armstrong *et al.* 2011). As the mountain lion population density increases, the mortality rate from intraspecific strife, cannibalism, and dispersal into marginal quality, unoccupied habitats also increases. Shaw (1981) presented evidence that livestock such as sheep and calves provide a supplemental prey base that supports mountain lions through seasonal declines in their primary prey. This allows an artificially high population level to be reached, especially during times of low wild prey availability. Although the relationship of the mountain lion to its prey can help mountain lion populations to increase, intraspecific competition is a greater factor in determining peak density for a particular site. They typically do not reach the high density levels observed in a number of other wildlife species, largely due to social intolerance combined with large home ranges. Home ranges up to 270mi^2 for females and 320mi^2 for males have been reported (Armstrong *et al.* 2011, Pierce and Bleich 2003, Lindzey 1999).

CPW manages mountain lions as a big game species in Colorado, and is responsible for compensating livestock losses. CDA has authority for the management of livestock losses to lions. They issue depredation permits when needed per Colorado regulations, but permits are not required prior to take of mountain lions threatening livestock. WS-Colorado has been contracted by CPW to assess damage and provide mountain lion damage management for them as needed.

Published mountain lion densities, based on a variety of population estimating techniques, range from a low of about 1/100 mi^2 (McBride 1977, Hemker *et al.* 1984) to a high of 24/100 mi^2 (Johnson and Strickland 1992). The average density estimate for western states has been estimated at 7.5/100 mi^2 (Johnson and Strickland, 1992). Cunningham *et al.* (1995) determined that mountain lion densities were about 75% higher in the portion of their study area which was subject to greater depredation control and sport hunting. Their estimates of density ranged from 4-7/100 mi^2. However, studies that followed mountain lions for at least 12 months found a wider range of densities: 1.3-13/100 mi^2. CPW uses density estimates of 5-12/100 mi^2, which is within the range of the estimates for lions followed for at least 12 months (Logan 2005). Using 7 mountain lions/100 mi^2 (intermediate density for Colorado), and considering that mountain lions occupy approximately 2/3 of Colorado, we believe that 4,850 is a conservative estimate of the population of mountain lions in Colorado. This estimate is in agreement with CPW's estimate of 3,000-7,000 mountain lions (CPW 2017b).

Several studies on mountain lion population dynamics provide insights into long-term sustainable harvest levels. Ashman *et al.* (1983) found that a mountain lion population in Nevada had the recruitment capacity (reproduction and immigration) to rapidly replace annual losses under "moderate to heavy exploitation of 30%-50% removal". Logan *et al.* (1996) determined the rate of increase in a New Mexico population varied from 8-11% in an un-hunted and uncontrolled population, to 21-28% in a population where harvest and control was simulated by removing 50% of the lions from the study area. They concluded that rates of increase in mountain lion populations are density dependent; as a population declines in relation to carrying capacity, the rate of increase becomes higher. This is a natural mechanism of wildlife populations that serves to protect species by enhancing the ability of populations to recover from declines. Logan *et al.* (1996) suggested that, for a lion population to remain at or near maximum carrying capacity, no more than 11% of the adults should be harvested annually. They also stated that the harvest level might need to exceed 28% per year to produce a substantial decline in the population, as may be desired if a State determines that a population is too high. They further determined that a viable population can be maintained at about 50% of carrying capacity with harvest levels that range from 21% to 28%. Consequently, the long-term sustainable harvest threshold may vary from 11% to 28%, depending on the size of the population that is desired (100% or 50% of carrying capacity).

We use the most conservative estimate of 11% for this analysis. However, state wildlife agencies will sometimes allow a greater percentage of mountain lions to be harvested in order to reach management goals. CPW intensively manages mountain lion populations and makes decisions about annual harvest rates. CPW may decide to effect a decrease in the mountain lion population when it determines the population to be too high in a specific area, or statewide. Such population management can generally be accomplished through hunting regulations. However, WS-Colorado may also be asked to assist, because as mountain lion populations decrease, hunting pressure declines, and hunter harvest can also be reduced by poor snow conditions (Hurley *et al.* 2011). WS-Colorado's involvement in the take of mountain lions in such a scenario would not be considered significant impact.

Localized populations of mountain lions can be harvested more intensively, partly due to immigration. A localized population can recover to pre-harvest levels in 9 months when 36% of the local population is harvested, and 31 months when 47% of the population is harvested (Lindzey *et al.* 1992, Logan and Sweanor 2001). Another study by Logan *et al.* (1996) showed that mountain lion populations would recover within three years when 53% of the mountain lion population was removed. Increased localized mountain lion harvest may be conducted to protect mule deer in Colorado at rates up to 36% of the local mountain lion population in the CPW Piceance Basin predator study (Appendix G) (C. Anderson, CPW, pers. comm, Sep 16, 2016). CPW might remove up to 50% of the local mountain lion population in the Upper Arkansas predator study (Appendix H). An analysis of mountain lion take at local or regional levels is outside the scope of this EA, because (1) the need for PDM is generally unpredictable, (2) population estimates may have large variances, and (3) localized impacts would be temporary. Additionally, the number of mountain lions taken by WS-Colorado is negligibly compared to the statewide population, and is a small fraction of the cumulative harvest, as discussed below. Such analyses would be needlessly complex, because they would not provide actionable information. CPW collects sportsman harvest data at these levels, much of which can be found on their website (CPW 2017a).

The majority of mountain lion incidents involve depredation of livestock, pets, and sometimes people. WS-Colorado recorded an average of $40,653 per year in losses (13% of all predator damage) to livestock, pets and zoo animals, and human health & safety. Lions killed an average of 106 livestock annually in FY12-16, as well as one pet and one zoo animal within this five-year timeframe. Lions were also responsible for one human attack. Mountain lion predation on wildlife species such as bighorn sheep and mule deer has created concern in some western states, but these losses are not reported to WS-Colorado, so we do not have data on any such losses.

Direct Impacts: WS-Colorado took an average of 10 mountain lions per year (0.2% of the population), with a range of 5 to 17 during FY12-16 (Table 3-8). Under Alternative 1, mountain lion take by WS-Colorado may increase over these levels due to additional resources, and projects to protect mule deer from mountain lion predation or study the impact of mountain lion predation on mule deer. We anticipate that WS-Colorado would take no more than 40 mountain lions in any year, which is 0.8% of the statewide population. This level of take is expected to result in minimal, short-term impacts on mountain lions locally, and no impact on the statewide mountain lion population. Cumulative harvest rates managed by CPW would likely maintain mountain lion populations at or near biological carrying capacity (see below). WS-Colorado's take of mountain lions is generally in response to requests by state agencies to remove problem lions. In the absence of these actions by WS-Colorado, the lions would likely still be removed either by the state agencies, agricultural producers, or their agents.

In locations where mountain lion populations are being managed by CPW in order to protect mule deer populations, or to study those impacts, local mountain lion populations might be moderately impacted. However, these moderate impacts would be temporary, and would not impact the statewide population. Local harvest rates higher than 11% of the estimated local population (up to 53%) would be considered moderate impact; however, the impact would be temporary, and these populations would be expected to recover within three years (Logan *et al.* 1996).

Under Alternative 1, there would be no significant impacts to either local or statewide mountain lion populations.

Table 3-8. Overview of mountain lion impact analysis.

Year	WS Take	Sportsman Harvest[a]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	10	383	393	4,850	0.21%	8.1%	11%	No
FY 2013	17	467	484	4,850	0.35%	10.0%	11%	No
FY 2014	7	442	449	4,850	0.14%	9.3%	11%	No
FY 2015	5	467	472	4,850	0.10%	9.7%	11%	No
FY 2016	13	427	440	4,850	0.27%	9.1%	11%	No
Average	**10**	**427**	**437**	**4,850**	**0.21%**	**9.0%**	**11%**	**No**

[a]Sportsman Harvest estimate not available for FY16, so the average of the five most recent estimates is used. This includes 2010-11, 2011-12, 2012-13, 2013-14, and 2014-15 seasons. This average is also used for the FY16 sportsman harvest estimate. Data from CPW (2016).

Indirect Impacts: Intentional high harvest rates might be implemented by CPW to allow ungulate populations to reach population objectives, to study these effects, or for local populations higher than desired. Once objectives are met, CPW might relax mountain lion harvest rates. Depending on the percentage of the lion population reduced, recovery to the original population level may take 1-3 years. Due to their low densities, high dispersal rates, long dispersal distances, and social intolerance, we do not anticipate any impact on immigration rates, dispersal distances, fecundity, or age structure due to PDM conducted by WS-Colorado.

It has been suggested that increased mountain lion harvest may lead to increased infanticide (Cooley *et al.* 2009, Ruth *et al.* 2011). In support of this supposition, cub survival has been shown to be higher with increased density of adult male mountain lions (Ruth *et al.* 2011). Also, infanticide mostly occurs in winter when the territories of resident males and immigrating males overlap (Ruth *et al.* 2011). However, recent mountain lion research in Colorado has shown higher infanticide rates during a 5-year non-hunting period than the subsequent 5-year hunting phase of the study (Logan 2015). Also, infanticide from male pumas was the main cause of death for cubs in the absence of sport hunting (Logan 2014).

Increased harvest of male lions has been suggested to lead to increased sub-adult males in the population, and subsequently, increased changes in territory (Logan and Sweanor 2010, Ruth *et al.* 2011).

Cumulative Impacts: Sportsman harvest averaged 427 mountain lions, with a range of 383 to 467 (Table 3-8, CPW 2017b). Cumulative take averaged 437, with a maximum of 484 in FY13. This corresponds to an average of 9%, with a maximum of 10% of the estimated mountain lion population (Table 3-8). This cumulative lion take of less than 11% during this 5 -year period would be expected to maintain the mountain lion population at carrying capacity (Logan *et al.* 1996).

Mountain lion populations are managed intensively by CPW, and decisions about annual harvest rates are determined by the State of Colorado, which may decide to effect a decrease in the population if they determine the population to be too high. The consistent maintenance of cumulative take just below 11% of the population is an indication of the State's intensive management, as well as their current goals regarding the lion population, as discussed above. WS-Colorado's involvement in the take of mountain lions in such a scenario would be considered a benefit to the environment whenever the decisions are based on biologically and ecologically sound principles, the goals are in accordance with the carrying capacity, and the actions would not negatively impact the sustainability of the mountain lion population, locally or statewide. Similar to black bear management discussed above, WS-Colorado's involvement should actually be *beneficial* because it will help the State of Colorado to achieve its management goals. It will also improve the ability of CPW to control lion mortality because WS-Colorado is more likely to correctly target problem lions, whereas private resource owners may not reliably kill the target lion.

CPW has management objectives for the 19 mountain lion data analysis units (DAUs) in Colorado. Hunter harvest and non-hunter mortality objectives have been set. CPW uses a 5-year average of harvest to estimate mortality (hunter and non-hunter), and to determine the harvest potential for a DAU, and to set the next season's quota. WS-Colorado take is included in the CPW analyses. Based on CPW analyses, cumulative take is not impacting the population in any DAU. CPW can and will reduce the quota in an area where they suspect an over-harvest has occurred or can increase licenses in areas where the population is higher than the desired objective.

Under Alternative 1, we anticipate slightly higher cumulative mountain lion take, but not generally higher than 534 mountain lions, or 11% of the statewide population. This may include localized take up to 50% of local populations. And statewide cumulative take may exceed 11% in some years, especially when the state may decide to decrease the mountain lion population. Cumulatively under Alternative 1, we anticipate moderate short-term impacts to some localized mountain lions populations. The cumulative impact on the statewide mountain lion population is likely to be low, but could be higher. These local and statewide impacts would be at the direction of, and under the control of CPW, as discussed. WS-Colorado would have no authority and no ability to alter these impacts on mountain lions, and WS-Colorado's contribution to such impacts would be negligible.

CPW has management authority over the management of mountain lions in Colorado, and the decision of CPW to effect a change in the population of mountain lions would not necessarily be considered a significant impact, as discussed in Section 1.16.3. In order to be considered significant, the magnitude of the population change must be substantial, such as a change which results in the population being unable to sustain itself, major changes to other species populations, major alterations in ecosystem function (such as biodiversity or trophic cascades), or other significant impacts on the quality of the human environment (including increased predator damage). We do not anticipate any such impacts under Alternative 1.

Throughout their range, mountain lion populations are considered to be decreasing, but they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.7 Impact on Feral Cats:

Feral cats are fairly common throughout Colorado, and primary responsibility for feral cat control rests with county and local authorities, such as local law enforcement and health departments. WS-Colorado primarily responds to requests from these local authorities to target feral cats, but occasionally targets feral cats at airports. WS-Colorado receives few such requests. WS-Colorado personnel are authorized to control feral cats to protect livestock, poultry, natural resources, and human health & safety when requested by the proper authority. Feral cats are not native to North America. As such, they are not part of the natural environment, and are generally considered ecological pests. They are very efficient predators of native wildlife and competitors to native predator species (Coleman and Temple 1993, American Bird Conservancy 1997, Lepczyk *et al.* 2003).

Direct, Indirect, and Cumulative Impacts: WS-Colorado killed an average of 7 feral cats annually during FY12-16, with a maximum of 14 in FY12 (Table 3-1). An additional 11 non-target feral cats were captured and released during this 5-year timeframe (average of 2 per year). Under Alternative 1, we anticipate that feral cats would continue to be taken occasionally by WS-Colorado, with a maximum of 25 in any year. The take of feral cats by WS-Colorado under Alternative 1 is considered to be insignificant, and may have beneficial effects on native wildlife populations. We are not aware of any indirect impacts to feral cats due to PDM conducted by WS-Colorado. Cumulative impacts to feral cats were not analyzed because feral cats are non-native, and are generally considered to have a negative impact on the ecosystem, especially native bird populations (Coleman and Temple 1993, American Bird Conservancy 1997, Lepczyk *et al.* 2003, Jessup 2004, The Wildlife Society 2011, Loss *et al.* 2013). The effect of feral cat removal would likely be positive, especially for wild birds. A summary of this impact analysis is provided in Table 3-2.

3.1.1.8 Impact on American Badger Populations:

American badgers (*Taxidea taxus*) are found throughout most of the western States and are found throughout Colorado at moderate densities. Badgers occur in most open habitats in Colorado, but avoid densely wooded areas, although they will enter forest margins (Armstrong *et al.* 2011). Their distribution is commonly associated with fossorial (below ground) prey such as prairie dogs (*Cynomys spp.*) and ground squirrels (*Spermophilus*, *Otospermophilus*, and *Ictidomys*). Density estimates range from $1/mi^2$ to $13/mi^2$ (Messick 1999). We believe that 52,000 badgers is a conservative estimate of the population in Colorado, using the lowest published density estimate of $1/mi^2$, and considering that approximately half of the State provides suitable habitat.

Boddicker (1980) has suggested that the long-term sustainable harvest threshold is above 30-40%. These rates may be based only on experience, and not on any empirical data, so they may not be accurate. Banci and Proulx (1999) reported the sustainable harvest rate to be between 10% and 25% in Canada, including areas of recent badger range expansion. The sustainable harvest rate is likely to be higher in more established populations, such as in Colorado, but we are not aware of any other published sustainable harvest rates for badgers. Historic sportsman harvest of badgers in Colorado can give us some information. Estimated harvest in 1986-87 was 2,276 badgers, which did not appear to negatively affect the population, because 3,211 badgers were harvested the following year (CPW 2016a). After the 1987-88 trapping season, badger harvest decreased, which may be due to lower fur prices, which dropped for many species during this period (see discussion on marten). The harvest of 2,276 badgers in 1986-87 represents 11% of the estimated badger population in Colorado. Due to the paucity of data, we will use the low end of the reported threshold, 10%, as a very conservative estimate for this analysis.

During FY12-16, WS-Colorado recorded an annual average of $139 in losses due to badgers. CPW estimates that sportsmen harvested an annual average of 224 badgers in Colorado in recent years (Table 3-9; CPW 2016a). Badgers are classified as furbearers in Colorado and managed by CPW. WS-Colorado occasionally takes badgers, most often for the protection of property (*e.g.*, rangeland, pasture, and cropland damage) or human health & safety (*e.g.*, threat of wildlife strikes to aircraft).

<u>Direct Impacts</u>: WS-Colorado took an average of 5 badgers annually during FY12-16, with a maximum of 12 badgers in FY12 (Table 3-9). This corresponds to an average of 0.01%, with a maximum of 0.03% of the estimated statewide badger population (Table 3-9). Under Alternative 1, we anticipate that WS-Colorado would take up to 20 badgers in any year, which corresponds to 0.04% of the estimated badger population. These levels of take would have negligible impacts on local badger populations, and no impact on the statewide badger population.

<u>Indirect Impacts</u>: We considered potential impacts due to increased immigration rates and distances, and increased fecundity, potentially resulting in changes in local population age structure. However, due to the negligibly low numbers of badgers expected to be taken (up to 0.04% of the estimated population), we do not expect any significant indirect impacts to badgers due to PDM conducted by WS-Colorado.

Table 3-9. Overview of badger impact analysis.

Year	WS Take	Sportsman Harvest[b]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	14	224	238	52,000	0.03%	0.5%	10%	No
FY 2013	6	224	230	52,000	0.01%	0.4%	10%	No
FY 2014	2	224	226	52,000	0.00%	0.4%	10%	No
FY 2015	3	224	227	52,000	0.01%	0.4%	10%	No
FY 2016	2	224	226	52,000	0.00%	0.4%	10%	No
Average	**5**	**224**	**229**	**52,000**	**0.01%**	**0.4%**	**10%**	**No**

[b]Sportsman Harvest not available for most years, so average of the 5 most recent years with available data is used: 2004-05, 2006-07, 2009-10, 2011-12, and 2012-13. Data from CPW (2016).

<u>Cumulative Impacts</u>: Sportsman harvest estimates are not available from most years during FY12-16, so we used the average of the five most recent years with available data: 2005-05, 2006-07, 2009-10, 2011-12, and 2012-13. This average is 224 badgers (Table 3-9; CPW 2016a). Cumulative harvest averaged 229 (0.4% of the population), with a maximum of 238 (0.5% of the population). Under Alternative 1, we anticipate cumulative take of no more than 700 badgers in any year, which is 1.3% of the statewide badger population. This is much lower than the lowest published sustainable harvest threshold (10%). This maximum cumulative take is also very low compared the 11% harvest rate from the 1986-87 trapping season in Colorado discussed above. Under Alternative 1, we anticipate negligible impacts to local badger populations, and no impact to the overall badger population in Colorado.

Throughout their range, American badger populations are considered to be decreasing, but they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.9 Impact on Virginia Opossum Populations:

The Virginia opossum (*Didelphis virginiana*) is native to three river basins in eastern Colorado. They expanded their range in these areas during the late 1900s, most likely as a result of agriculture. They have also been introduced elsewhere in Colorado such as in Grand Junction. They are most abundant in riparian areas, but also inhabit deciduous woodlands, cottonwood forests, pinyon-juniper woodlands, farmlands, old fields, grasslands, marshlands, agricultural and forested edges, and desert plains. Opossums have also been reported in mountainous areas. Opossums are omnivorous and have a wide-ranging diet. Females breed in their first year, and produce potentially two litters per year in Colorado. They may have as many as 25 young per litter, but average between six and nine. Most opossums die in their first year, and turn-over is expected by their third year (Armstrong *et al.* 2011). Opossum populations can fluctuate dramatically. Opossums occupy about 7% of the state (Armstrong *et al.* 2011) and their density ranges from 1.3/mi^2 to 20.2/mi^2 with an average of 10.1/mi^2 (Seidensticker *et al.* 1999). Using the low density estimate of 1.3/mi^2, we believe that a statewide population of approximately 9,500 opossums is a conservative estimate.

CDA manages opossum damage to agriculture. CPW manages the opossum and damage to non-agricultural related resources. The Virginia opossum is protected as a furbearer in Colorado, but few are harvested by sportsmen

No long-term sustainable harvest estimate is available for opossums, though it is likely high as long as refuges (areas where they are not hunted) for them are maintained (Seidensticker *et al.* 1999). In the absence of any reliable data on sustainable harvest, we will use the lowest reported rate for any predator analyzed in this EA, 10%, as an extremely conservative estimate.

<u>Direct Impacts</u>: WS-Colorado lethally took an average of 2 opossums annually during FY12-16, with a high of 5 in FY16 (Table 3-10). Under Alternative 1, we anticipate that WS-Colorado would continue to take a few opossums annually, with a maximum of 10 in any year. This represents 0.1% of the opossum population, which would have negligible impacts on local opossum populations, and no impact on the statewide population.

<u>Indirect Impacts</u>: We are not aware of any indirect impact to opossums due to PDM conducted by WS-Colorado, except that WS-Colorado personnel may hit one with an automobile occasionally.

<u>Cumulative Impacts</u>: Sportsman harvest is estimated at 45 per year based on the 2009-10 estimate, which is the only estimate available in the last 20 years (CPW 2016a). The hunting and trapping seasons were closed in 1995, and then re-opened in 2009. CPW calculated a sportsman harvest estimate the following year, but has not calculated one since. Cumulative take was 45, which is less than 0.5% of the estimated statewide population (Table 3-10). Under Alternative 1, we anticipate cumulative take of up to 200 opossums, which comprises 2% of the estimated population. This level of take is expected to have a negligible impact on local opossum populations, and no effect on the statewide population. In fact, historic sportsman harvest of opossums averaged 204 over a 10-year period (1987-1996; CPW 2016a), without any apparent negative affect on the population. If this harvest rate were not sustainable, it could not have lasted for 10 years.

Virginia opossum populations are considered to be increasing throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

Table 3-10. Overview of Virginia opossum impact analysis.

Year	WS Take	Sportsman Harvest[a]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	0	45	45	9,500	0.00%	0.5%	10%	No
FY 2013	1	45	46	9,500	0.01%	0.5%	10%	No
FY 2014	0	45	45	9,500	0.00%	0.5%	10%	No
FY 2015	2	45	47	9,500	0.02%	0.5%	10%	No
FY 2016	5	45	50	9,500	0.05%	0.5%	10%	No
Average	**2**	**45**	**47**	**9,500**	**0.02%**	**0.5%**	**10%**	**No**

[a]Sportsman harvest data not available during FY12-16. The only estimate available during the last 20 years is from the 2009-10 season. This number is used for all sportsman harvest because it is the only information available. Data from CPW (2016).

3.1.1.10 Impact on Bobcat Populations:

Bobcats (*Lynx rufus*) are found throughout much of North America, excluding much of Canada and portions of the eastern U.S. They are most abundant in southeastern states with moderate densities in the western states (McCord and Cardoza 1982). In the west, bobcats are typically associated with rimrock and chaparral habitat, but can be found in other habitats such as forests. They are found statewide in Colorado, but avoid open areas and populated areas. Highest densities are in western and southeastern Colorado (Armstrong *et al.* 2011). Bobcats reach reproductive maturity at approximately 9 to 12 months of age and may have one to six kittens following a two-month gestation period (Crowe 1975, Koehler 1987). They may live up to 14 years, but annual mortality can be as high as 47% (Rolley 1985).

Bobcat population densities range between 0.1/mi^2 and 7/mi^2 according to published estimates (Rolley 1999, McCord and Cardoza 1982). In the prior EA (WS 2017a), we used the lowest reported density of 0.1/mi^2; however, this was extremely conservative. Moreover, bobcat populations have been increasing since the Rolley (1999) estimates were published (Roberts and Crimmins 2010), and the sportsman harvest in Colorado has increased accordingly. These higher rates of sportsman harvest require a closer look at the likely population in Colorado.

No estimate of the statewide bobcat population is available for Colorado. A more recent study estimated bobcat density in fragmented landscapes, where populations were expected to be low, between 0.65 and 1.1/mi^2 (Ruell *et al.* 2009). In a survey of North American wildlife management agencies, Roberts and Crimmins (2010) reported bobcat populations for several states neighboring Colorado: Arizona (62,395-65,909 bobcats), Kansas (29,666-31,785), and New Mexico (36,249-54,373). Using the lowest numbers of these ranges, the statewide bobcat density in these states is conservatively estimated at 0.55/mi2 (Arizona), 0.36/mi2 (Kansas), and 0.30/mi2 (New Mexico). Using the lowest reported density estimate in these studies (0.3/mi^2) as the average for Colorado, we believe that 31,200 bobcats is a conservative estimate of the population in Colorado. In fact, the bobcat density in Colorado is probably much higher than in the neighboring states used for this estimate, because Colorado has more suitable bobcat habitat than these states, which all contain larger amounts of open grassland and desert plains.

CPW (2016a) uses 17% as the long-term sustainable harvest threshold for bobcats, and we will use this number for our analysis.

CPW is responsible for the management of bobcats, which are designated as furbearers. CDA has authority over the management of bobcats which depredate on livestock. WS-Colorado works with CDA and CPW to provide PDM to reduce bobcat damage, especially to livestock. WS-Colorado provides CPW with information on take for population management purposes. WS-Colorado recorded an annual average of $413 in losses due to bobcat damage in Colorado during FY12-16. Damage caused by bobcats was almost exclusively to livestock, especially domestic fowl and lambs. Threats to property, natural resources, and human health & safety were also recorded, but no dollar losses were reported.

Bobcats are intensively managed by CPW at statewide, regional, and local scales. If bobcat mortality exceeds their thresholds in any area or on any scale, CPW has the authority and intent to change bobcat management rules, such as seasons, methods, and bag limits. WS-Colorado take is included in cumulative mortality analyzed annually by CPW, and the State's management objectives are not influenced by WS-Colorado. As such, WS-Colorado has little or no ability to impact bobcat populations in Colorado. In the interest of transparency, however, we have analyzed direct, indirect, and cumulative impacts.

Direct Impacts: WS-Colorado took an average of 1 bobcat annually during FY12-16. Maximum WS-Colorado bobcat take was 4 in FY12. This corresponds to an average of 0.01%, with a maximum of 0.04% of the estimated statewide bobcat population. WS-Colorado take was also a very small fraction of the total take: a maximum of 0.24% (Table 3-11). These levels of take are negligibly low compared to the population, and to total take. Under Alternative 1, we anticipate that bobcat take by WS-Colorado would remain very low, up to 10 bobcats in any year, which corresponds to 0.1% of the statewide population. This level of take would be expected to have a negligible impact on bobcats locally, and no impact on the statewide bobcat population.

Table 3-11. Overview of bobcat impact analysis.

Year	WS Take	Sportsman Harvest[a]	Other Take[a]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	4	1,628	39	1,671	31,200	0.01%	5.4%	17%	No
FY 2013	0	1,854	40	1,894	31,200	0.00%	6.1%	17%	No
FY 2014	1	1,945	58	2,004	31,200	0.00%	6.4%	17%	No
FY 2015	0	1,634	40	1,674	31,200	0.00%	5.4%	17%	No
FY 2016	1	1,352	47	1,400	31,200	0.00%	4.5%	17%	No
Average	**1**	**1,683**	**45**	**1,729**	**31,200**	**0.00%**	**5.5%**	**17%**	**No**

[a]Other Take includes game damage, 30-day permits, and roadkill, as reported by CPW (2016). Other Take excludes WS-Colorado take, which is included in CPW (2016) data. Sportsman harvest data from CPW (2016).

Indirect Impacts: We considered potential indirect impacts due to increased immigration rates and distances, and increased fecundity, potentially resulting in changes in local population age structure. However, due to the negligibly low numbers of bobcats WS-Colorado might take under Alternative 1 (less than 0.1% of their estimated population), any indirect impacts of such take would be negligible.

Cumulative Impacts: Sportsman harvest ranged from 1,352 to 1,945, with an average of 1,683 annually during FY12-16 (Table 3-11; CPW 2016a). A few dozen bobcats are knows to be hit by cars each year. Whereas this does not constitute "take", we nonetheless include these losses in our analysis because it adds to the cumulative impact of human activity on bobcats. We know of no other sources of bobcat losses, other than natural causes (*e.g.*, disease, starvation). Such natural factors are taken into account when determining sustainable harvest thresholds, so they will not be analyzed here. Cumulative take averaged 1,730 bobcats, with a range of 1,400 to 2,004. These numbers represent an average of 5.5% of the bobcat population, with a maximum of 6.4% in FY14. Cumulative take was well below the 17% sustainable harvest threshold throughout our 5-year analysis period. Under Alternative 1, we anticipate cumulative take to vary with fur prices, but we don't expect it to exceed the 17% sustainable harvest threshold. As such, we expect the impact to local bobcat populations to be low, and that there will be no impact to the statewide bobcat population. The results of our analysis match the results of an analysis by CPW (2016a), who analyzed all bobcat mortality at statewide, regional, and local scales. They found that total mortality has decreased since 2014, and has consistently remained below the sustainable threshold at all scales (local, regional, and statewide). They concluded that the bobcat population is increasing slightly statewide, and at most other levels. Based on this analysis, they did not recommend changing bobcat management rules, such as seasons, methods, and bag limits.

Bobcat populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.11 Impact on Swift Fox Populations:

The swift fox (*Vulpes velox*) is a grassland species found in most of eastern Colorado, covering about 35% of the State (Armstrong *et al.* 2011, CPW 2016a). They prefer areas with loose-textured soils suitable for easily digging underground dens which are used throughout the year. Swift fox are most common in areas that support large populations of prey such as black-tailed jackrabbits (*Lepus californicus*), cottontail rabbits (*Sylvilagus spp.*), kangaroo rats (*Dipodomys spp.*), deer mice (*Peromyscus spp.*), birds, and insects. They reach reproductive maturity between 10 and 22 months of age and litters average 3-5 pups.

Swift fox populations were reduced in the early 20th century as a result of rodent and predator poisoning campaigns. In the early 1990's they were considered for listing as federally threatened under the Endangered Species Act. In 1994, threatened status was determined to be "warranted but precluded" by the USFWS (1995). The Swift Fox Conservation Team was formed in 1994 to address the declining population (Dowd Stukel 2017), and the hunting/trapping seasons in Colorado and other states were closed. Since then, recovery efforts have been successful, and the swift fox was removed as a candidate for threatened status in 2001 [66 Federal Register 1298 (01/08/2001)]. In 2009, the swift fox hunting and trapping seasons were re-opened in Colorado. Since 2010, CPW sportsman harvested an estimated average of 214 swift fox annually in Colorado, although historic take was considerably higher (up to 2,210 in 1987; CPW 2014b, 2016a). In fact, before the trap ban in 1996, Colorado had the highest sportsman harvest among the states in their range (Scott-Brown *et al.* 1999).

Data on swift fox density is limited, but in eastern Colorado it has been shown to range from 0-2.2/mi^2, with an average density of 0.4/mi^2 (Finley 1999, Finley *et al.* 2005). We consider a density of 0.25/mi^2 to be a conservative estimate for swift fox in Colorado. Thus, over their range of 35% of the State, and using 104,000 mi^2 for the area of Colorado, our conservative estimate of the swift fox population in Colorado is approximately 9,100 individuals.

We know of no published long-term sustainable harvest rates for swift fox. CPW uses 15% as their sustainable harvest rate for swift fox management analyses (CPW 2016a), so we will use this figure also as a conservative estimate of swift fox sustainable harvest. Swift fox can occasionally be found on the fringe of agricultural lands, and are therefore capable of causing damage to agricultural resources.

Direct Impacts: Damage from swift foxes is sporadic and limited in Colorado. WS-Colorado took an average of one swift fox per year during FY12-16. Swift fox take ranged from 0 to 4, including 2 taken as non-targets in FY16 and 4 targeted in FY14. No swift fox were taken in FY12, 13, or 15 (Table 3-12). WS-Colorado rarely targets this species during PDM because they infrequently cause damage. Under Alternative 1, we anticipate occasional and sporadic take of swift fox, with a maximum annual take of 10. This represents 0.1% of the statewide swift fox population; thus, we anticipate a negligibly low impact to swift fox locally, and no impact on the statewide swift fox population.

Indirect Impacts: Local decreases in interspecific competition due to the take of coyotes and red fox may allow for increases in local swift fox populations, which may be beneficial. However, these local effects are not likely to affect the statewide swift fox population. It is extremely unlikely that sporadic and occasional take of swift fox by WS-Colorado would result in any impact on dispersal rates, dispersal distances, fecundity, or age-structure. We know of no other indirect impacts to swift fox due to PDM conducted by WS-Colorado. We anticipate the indirect impacts to the statewide swift fox population to be negligible.

Table 3-12. Overview of swift fox impact analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2012	0	107	107	9,100	0.00%	1.18%	15%	No
FY 2013	0	381	381	9,100	0.00%	4.19%	15%	No
FY 2014	4	416	420	9,100	0.04%	4.62%	15%	No
FY 2015	0	609	609	9,100	0.00%	6.69%	15%	No
FY 2016	2	333	335	9,100	0.02%	3.68%	15%	No
Average	**1**	**333**	**334**	**9,100**	**0.01%**	**3.67%**	**15%**	**No**

[a]WS Take is all lethal take, including nontarget take.

[b]CPW sportsman harvest estimate for 2016 was 11,417 swift fox, which is higher than the population. Refer to species account for more on this statistical/sampling error. The average of the 2010-2015 estimates is used instead. This number is also used for the average. Data from CPW (2016).

Cumulative Impacts: The 2015-16 sportsman harvest estimate for swift fox is a prime example of the problem with extrapolating statewide harvest numbers from a small sample of hunter/trappers. This is especially problematic for species which are not commonly hunted/trapped, such as swift fox, for which survey data are extrapolated from very few responses. In this case, the 2015-16 harvest estimate (11,417) is clearly erroneous; it exceeds the estimated population (9,100). CPW is currently assessing their survey methodology (CPW 2016a). In the interest of transparency, we report the best available data, including the 2015-16 estimate; however, using this estimate to determine cumulative swift fox take in Colorado would be imprudent. Therefore, we have excluded it, and used the five most recent years with available data: 2009-10, 2011-12, 2012-13, 2013-14, and 2014-15. Sportsman harvest estimates ranged from 107 to 609 with an average of 333 (Table 3-12; CPW 2016a).

We know of no other take of swift fox in Colorado. Average cumulative take was 334, with a maximum of 609 in FY15. These numbers represent 3.7% and 6.7%, respectively, of Colorado's estimated population of 9,100. Under Alternative 1, we anticipate annual cumulative take to be less than 900, which represents less than 10% of the swift fox population. Historic sportsman harvest averaged 602 swift fox (6.6% of the population), with a high of 2,210 (24%) in 1986-87 (CPW 2016a). Under Alternative 1, cumulative impacts on local swift fox populations is anticipated to be low, and we anticipate no impact on the statewide swift fox population. This impact analysis comports with the 2015 analysis by CPW (2015a), in which they concluded that cumulative harvest was well below the sustained threshold limit at the regional and statewide scales.

Swift fox populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.12 Impact on Feral Dogs:

Feral and free-roaming dogs are somewhat common in Colorado. Requests for assistance with feral dogs are approved by the appropriate state or local agency, as regulated by Colorado State laws. WS-Colorado recorded an average of $3,916 in annual losses due to feral dogs during FY12-16. These were losses to livestock, including an average of 9 animals killed or injured per year.

<u>Direct, Indirect, and Cumulative Impacts</u>: WS-Colorado took an average of <1 feral dog per year in FY12-16 (Table 3-1). Under Alternative 1, we anticipate that WS-Colorado may take up to 5 feral dogs in any year. This level of take will have a low impact on the feral dog population in Colorado, which is considered slightly beneficial. Take of feral or free-ranging dogs by WS-Colorado is considered to have no deleterious impact on the human environment because feral dogs are not an indigenous component of the ecosystem in Colorado. Therefore, no further analysis of population impacts is provided. As a non-native species in Colorado, the removal of feral dogs is generally considered to have a positive impact on the environment. A summary of this impact analysis is provided in Table 3-2.

3.1.1.13 Impact on Feral Domestic Ferrets:

Domestic or European ferrets (*Mustela putorius furo*) are frequently sold as pets and may be intentionally released into the wild or escape captivity. Nationwide, APHIS-WS records only a few incidents of ferret damage annually. Once feral, they feed on small rodents, rabbits, and potentially poultry to survive. Feral ferrets are not part of the native environment, and are generally considered ecological pests. They are very uncommon in the wild, but they are sometimes encountered.

<u>Direct, Indirect, and Cumulative Impacts</u>: WS-Colorado did not take any feral domestic ferrets during FY12-16. However, WS programs in several other States have received requests for assistance for feral ferret damage in the past, and damage from this species is possible in the future. Under Alternative 1, WS-Colorado might take an occasional feral domestic ferret, up to 3 in any year. Any take of feral ferrets by WS-Colorado would have no detrimental impact to the environment, because domestic ferrets are not an indigenous component of ecosystem in Colorado. Any take by WS-Colorado would be considered to be a benefit to the ecosystem because they might otherwise cause damage. We are not aware of any indirect impacts of PDM conducted by WS-Colorado on feral ferrets. We did not analyze cumulative impacts because they are non-native species. A summary of this impact analysis is provided in Table 3-2.

3.1.1.14 Impact on Gray Fox Populations:

Gray fox (*Urocyon cinereoargenteus*) tend to prefer coniferous forests, chaparral, and rimrock country with scattered pinyon-juniper. To a lesser extent, they also occupy some agricultural habitats. They primarily feed on small mammals, birds, mast, and insects.

Gray fox have 3-7 pups per litter, and den in hollow logs, under rocks, and sometimes in underground dens. They are found in the foothills of the Front Range, throughout southeastern Colorado, and at lower elevations in the western fifth of the State; they occupy approximately 35% of the State (Armstrong *et al.* 2011). The gray fox has expanded its range, and therefore probably has a higher population than its historic abundance. Harvest by sportsmen averaged 697 during FY12-16 (CPW 2016a). Published estimates of gray fox range from 3.1-5.4/mi^2 with densities probably lower over broader areas (Fritzell and Haroldson 1982, Fritzell 1999). Because gray fox occur spottily throughout their range except in southern Colorado where they are more abundant, and using a density of 1.0/mi^2 over their range (one third of the lowest published density estimate), we believe that 36,000 gray fox is a conservative estimate of their population in Colorado. Long-term sustainable harvest rates for gray fox were estimated at 25-50% (Fritzell 1999). For this analysis, we will use the lowest reported number: 25%. Gray fox can cause agricultural damage, primarily to poultry, but gray fox damage in Colorado is infrequent.

Direct Impacts: WS-Colorado rarely takes gray fox during PDM, and did not take any during FY12-16. Under Alternative 1, we anticipate infrequent take of gray foxes by WS-Colorado, up to 5 in any year, which constitutes less than 0.1% of the statewide gray fox population of an estimated 36,000 individuals. Because gray fox take by WS-Colorado would be infrequent and sporadic, we anticipate no impact on local or statewide gray fox populations under Alternative 1.

Indirect Impacts: As discussed for red fox above, local decreases in interspecific competition due to the take of coyotes may allow for short-term increases in local gray fox populations. However, coyotes are likely to re-occupy these locations due to immigration, so this effect is unlikely. Any such local effects are not likely to affect the statewide gray fox population. It is extremely unlikely that sporadic and occasional take of gray fox by WS-Colorado would result in any impact on dispersal rates, dispersal distances, fecundity, or age-structure. We know of no other indirect impacts to gray fox due to PDM conducted by WS-Colorado. We anticipate that indirect impacts to local gray fox populations under Alternative 1 would be negligible, and we expect no indirect impact to the statewide population.

Cumulative Impacts: CPW estimates of sportsman harvest during FY12-16 averaged 697 per year, with a range of 164 to 1,047 (CPW 2016a). Because there was no other known take of gray foxes in Colorado during FY12-16, these numbers reflect the cumulative harvest also. We anticipate that less than 1,650 gray foxes (up to 5 by WS-Colorado, and potentially increased sportsman harvest) would be taken cumulatively under Alternative 1. This represents 4.6% of the estimated gray fox population in Colorado (36,000). Cumulative impacts would be negligible compared to the lowest reported sustainable harvest rate of 25%. A summary of this impact analysis is provided in Table 3-2.

Gray fox populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.15 Impact on Western Spotted Skunk Populations:

Three species of skunks have been known to inhabit Colorado: the striped, western spotted (*Spilogale gracilis*), and eastern spotted skunk (*S. putorius*). Records exist for a fourth, the hog-nosed skunk (*Conepatus leuconotus*), in southeastern Colorado, but no hog-nosed skunks have been found in Colorado since several were collected in the 1920s, so they may not exist in Colorado anymore. Additionally, eastern spotted skunks are spottily distributed within Colorado, and in fact may be extirpated from the state (Kahn 2001). Skunks are managed by CPW and protected under Colorado wildlife laws; however, hunting and trapping seasons only exist for the striped skunk and western spotted skunk. All skunk species have white on black pelage and have short, stocky legs with long claws used for digging. Their most notable characteristic is the ability to discharge nauseating musk from their paired anal glands.

Western spotted skunks are found sporadically along the Front Range from about Denver south and in southern and western Colorado, covering about 30% of the State (Armstrong *et al.* 2011). They are found in diverse habitats over small portions of the state preferring rocky canyons and outcrops in woodlands and prairies, especially shrub habitats in broken country. They often take advantage of the food and cover in agricultural areas. Spotted skunks make their dens in cracks and crevices among rocks, woodrat nests, hollow logs, burrows under large rocks, and sometimes under buildings. Unlike striped skunks, spotted skunks are adept climbers. They are almost entirely nocturnal and seldom are seen in the daytime. Western spotted skunks breed in late summer and fall, and exhibit delayed implantation (the eggs do not implant until spring and they then give birth in late spring or early summer following a 50-65 day gestation period). CPW estimates that there was no sportsman harvest of western spotted skunks in 2010, the only recent year for which data are available (CPW 2016a). Little information is available on spotted skunk densities. One study in Iowa found an average density of 5.7/mi^2 in appropriate habitat (Crab 1948 *in* Rosatte 1999). If spotted skunk densities are conservatively estimated at the lowest reported density for striped skunks (0.85/mi^2), the statewide population could be conservatively estimated at about 26,500.

We know of no published sustainable harvest threshold data for western spotted skunks. Due to the paucity of information, we will use the lowest reported long-term sustainable harvest rate for any of the predators analyzed in this EA (10%) as an extremely conservative estimate. Historically (1987-1996), sportsman harvest averaged 98, which suggests some level of sustainable harvest in Colorado (CPW 2016a).

Direct Impacts: WS-Colorado rarely receives complaints for damage due to western spotted skunks, and they are rarely targeted by WS-Colorado for PDM. WS-Colorado did not take any western spotted skunks during FY12-16, but they have been taken infrequently in prior years. Under Alternative 1, we anticipate that infrequent take of western spotted skunks is possible, with a maximum of 5 in any year (<0.02% of the estimated population). We anticipate this level of take to have negligible impacts on western spotted skunk populations locally, and no impact on the statewide population.

Indirect Impacts: It is extremely unlikely the infrequent take of a western spotted skunk could cause any indirect impacts to the species, including changes in dispersal rates, dispersal distances, fecundity, or age-structure. PDM conducted by WS-Colorado would not have any indirect effects on this species.

Cumulative Impacts: Sportsman harvest for western spotted skunk was estimated by CPW in 2010 (CPW 2016a) when the hunting and trapping season was re-opened, and that estimate was zero. Western spotted skunk harvest has not been estimated since then, and prior to that, the hunting and trapping season had been closed since 1995. Therefore, there has been no effect of cumulative take on western spotted skunk populations during FY12-16. Under Alternative 1, spotted skunks may be taken occasionally by WS-Colorado and/or sportsman. We anticipate a maximum cumulative take of 20 western spotted skunks in any year (<0.1% of the estimated population). This number is well below the sustainable harvest threshold of 10%, and well below the historical sportsman harvest estimates (average of 98 per year), and is expected to have a negligibly low impact on the statewide population. A summary of the potential impacts to western spotted skunks is provided in Table 3-2.

Throughout their range, western spotted skunk populations are considered to be decreasing, but they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.16 Impact on Weasel Populations:

Both long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*M. erminea*) are found in Colorado and CPW has management authority over weasels, which are classified as furbearers. The long-tailed weasel is more common and found in much of the continental U.S. including all of Colorado (Armstrong *et al.* 2011). They are found in a wide variety of habitats, usually brushy and rocky, and typically in close association with water.

Long-tailed weasel densities are estimated at 1/mi^2 over large areas, including non-preferred habitats. Densities as high as 98/mi^2 have been reported in high quality habitats (Fagerstone 1999). Using the most conservative estimate, we believe that 104,000 long-tailed weasels in a conservative estimate of the statewide population.

The short-tailed weasel is found mostly in northern North America and is found in the high country (above 6,000 ft.) of central Colorado covering about 40% of the State in mixed coniferous forest and alpine tundra associated with moist areas (Armstrong *et al.* 2011). Published densities for short-tailed weasels vary from 10/mi^2 to 16/mi^2 in preferred habitats (Fagerstone 1999). Assuming that preferred habitat covers approximately 10% of their range (the portion which is near water), and using the lowest published density of 10/mi^2, we believe that 40,000 short-tailed weasels is a conservative estimate of their population in Colorado.

Both of these weasel species primarily feed on small mammals and some birds. Historic sportsman harvest (1987-1994) is estimated at an annual average of 187 long-tailed weasels and 31 short-tailed weasels; however, no sportsman harvest of either species has been recorded in recent years (CPW 2016a). WS-Colorado has historically received few damage complaints for weasels, which have invariably been for the long-tailed weasel, and most always for poultry predation.

Long-term sustainable harvest rates were reported by Banci and Proulx (1999) to be 10-25% for long-tailed weasels, and 50-80% for short-tailed weasels. Sportsman took an average of 187 long-tailed weasels and 31 short-tailed weasels per year between 1987 and 1994 without any apparent effect on their populations (CPW 2016a).

Direct Impacts: WS-Colorado did not take any long-tailed weasels or short-tailed weasels during FY12-16, but damage from weasels has been recorded in prior years, and could occur in the future. Under Alternative 1, it is unlikely that WS-Colorado would take any weasels, but they may be taken infrequently, up to 2 long-tailed weasel, and 2 short-tailed weasel in any year. This level of take would result in negligible impacts to local weasel populations, and no impact to statewide weasel populations.

Indirect Impacts: We are not aware of any indirect impacts to long-tailed weasels or short-tailed weasels due to PDM conducted by WS-Colorado. WS-Colorado did not take any, so even local populations could not have been affected in any way. Under Alternative 1, we anticipate the possibility of infrequent take, which is unlikely to impact immigration rates or distances, fecundity, or age structure.

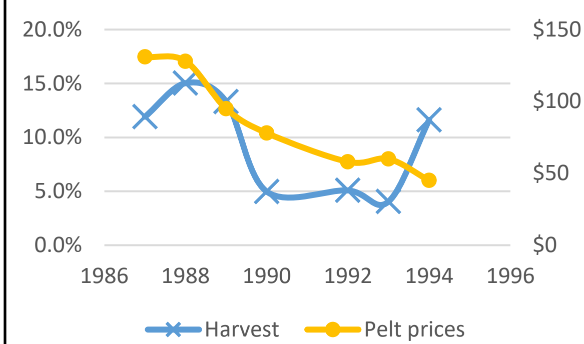
Cumulative Impacts: Sportsman harvest is estimated at zero based on the 2009-10 estimate. The hunting and trapping season were closed in 1995, and then re-opened in 2009. CPW calculated a sportsman harvest estimate the following year, but has not calculated one since. Cumulative take is also estimated at zero for each species during FY12-16 because no other data are available (CPW 2016a). Under Alternative 1, sportsman may harvest some in the future, and WS-Colorado could take a weasel infrequently if they cause damage. We anticipate maximum cumulative harvest of 50 long-tailed weasels and 10 short-tailed weasels, which are well below the historic harvest rates, and the lowest reported sustainable thresholds of 10% and 50% for long-tailed weasels and short-tailed weasels, respectively. These levels of cumulative harvest would be expected to have negligible impacts on local populations of long-tailed and short-tailed weasel populations, and no impacts at the statewide level. Summaries of these impact analyses are provided in Table 3-2.

Long-tailed and short-tailed weasel populations are considered to be stable throughout their ranges, and both species are listed as species of "least concern" according to the IUCN (2017).

3.1.1.17 Impact on American Marten Populations:

American marten (*Martes americana*), also known as pine marten, occur in spruce-fir forests and marginal alpine habitat where they feed on small mammals, particularly red squirrels (*Tamiasciurus douglasii*), birds, insects and mast. They climb and spend much of their time in trees, usually avoiding open areas. Males and juveniles appear the most susceptible to trapping (Strickland and Douglas 1999). In Colorado, martens occur in the high country, primarily in central and western Colorado, in about 20% of the State (Armstrong *et al.* 2011). Density ranges from 1/mi^2 to 5/mi^2 have been reported (Strickland and Douglas 1999). Using the lowest published density, we believe that 20,000 is a conservative estimate of the marten population in Colorado. Trappers harvested an annual average of 1,885 martens from 1987 to 1994 indicating their relative abundance. Typically the only damage that marten cause is from raiding mountain cabins. Although widespread in North America, marten populations have suffered declines in localized areas due to over-exploitation for furs and loss of habitat from lumbering operations and other activities. CPW is responsible for regulating take of this furbearer. Historical sportsman harvest of marten in Colorado has been estimated at 1,885 animals annually, which is an indication of their abundance. The marten season was closed in 1995, and then re-opened in 2006, after which estimated sportsman harvest was considerably lower (range 52-175). However, in recent years, estimated sportsman harvest has been higher: an average of 1,132 animals annually (Table 3-2; CPW 2016a).

Figure 3-2. Historic sportsman harvest (percent of estimated population) and pelt prices of marten in Colorado.



The long-term sustainable harvest rate for martens has been estimated at 10-25% (Banci and Proulx 1999, and references therein). Historical harvest data from Colorado show an average annual harvest of 1,885 marten (9.4% of the estimated population) between 1987 and 1996, with a range of 811 to 3,006 (4-15% of the population) (CPW 2016a). Marten harvest remained high (12-15% of the population) for 3 years in 1987-1989 (CPW 2016a), which suggests that these rates of harvest are below the sustainable harvest threshold. Harvest rates decreased over the next three years, but this followed a decreasing trend in pelt prices (Poole and Mowat 2001, Figure 3-2), which is the likely reason for the decrease. The increase in estimated harvest in 1994 while pelt prices were low is enigmatic, and the season was closed in 1995.

The most important factor in maintaining a healthy marten population is having refuge areas where they are not harvested (Strickland and Douglas 1999). For example, Hodgman *et al.* (1994) determined that marten were being overharvested on their study site in Maine, and their model showed a rapidly declining population. However, this area produced high trapping rates for at least a decade, which should not have been possible due to the apparent overharvesting. They concluded that immigration from a nearby refuge was responsible for the continuation of the population. Thus, it appears that marten can withstand locally high harvest rates, as long as there are unharvested refuges nearby. It is likely that such refuges are abundant in Colorado, due to the large amount of road-less public lands in marten habitat, where marten are not likely to be trapped. For this analysis, we will use the 1987-1989 Colorado marten harvest rates as an estimate of the sustainable harvest threshold, because marten populations in Colorado have been shown to withstand these harvest rates over several years, and because unharvested refuges are likely to be abundant in Colorado.

Direct Impacts: WS-Colorado did not take any martens during FY12-16. Under Alternative 1, it is unlikely that WS-Colorado would take any martens, but it is possible that they could be taken infrequently, up to 2 in any year. This represents 0.01% of the estimated marten population, which is expected to have no impact on martens, either locally or statewide.

Indirect Impacts: We are not aware of any significant indirect impacts to marten due to PDM conducted by WS-Colorado. Most PDM conducted by WS-Colorado occurs outside of marten habitat. The infrequent take under Alternative 1 would be unlikely to affect immigration rates or distances, fecundity, or age structure.

Cumulative Impacts: During FY12-16, sportsman harvest averaged 1,132 with a range of 139 to 2,018 (CPW 2016a). There was no other known means of take for martens, so these numbers reflect cumulative take also. This cumulative take represents an average of 6%, with a maximum of 10% of the estimated statewide marten population. Under Alternative 1, we anticipate the maximum cumulative take of martens in any year to be 2,300, which is 11.5% of the estimated marten population. We expect that this level of cumulative take would have a low impact on local marten populations, and no impact on the statewide marten population, because it is below the historic harvest levels (12-15% of the population). Whereas this level of cumulative take is close to the historic harvest levels used as the estimate of sustainable harvest, it should be noted that in most cases, 100% of this harvest would be sportsman harvest. If cumulative harvest were to reach these levels in the future under Alternative 1, WS-Colorado might contribute <0.1% of the cumulative harvest at most, which is negligible. In 2013-2014, CPW studied land use by martens, but did not look at abundance or density (CPW 2016a). A summary of this impact analysis is provided in Table 3-2.

Throughout their range, American marten populations are considered to be decreasing, but they are listed as a species of “least concern” according to the IUCN (2017).

3.1.1.18 Impacts on American Mink Populations:

CPW is the agency responsible to oversee the management of American mink (*Neovison vison*), which are classified as furbearers in Colorado. Mink are found across much of northern North America and in scattered areas of Colorado. Mink have never been very abundant in Colorado. They are associated with lakes, streams, and marshes and are typically found within a half mile of these riparian habitats. They feed on small mammals, birds, eggs, fish, insects, and amphibians and are especially prevalent where crayfish and muskrat (*Ondatra zibethicus*) are abundant (Armstrong *et al.* 2011). Published mink densities range from 8.5-22/mi^2 in wetland habitat, and 2.5-6 per mile of stream shoreline, but methods of estimating their density have varied greatly and have inherent inaccuracies (Eagle and Whitman 1999). In northwestern Colorado, mink density was estimated at 1.7/mi^2 over large areas (McKean and Burkhard 1978).

Because Colorado has low densities of mink statewide, and because CPW does not have density data for the rest of Colorado, we believe that a conservative estimate is 90,000 mink [half of the lowest reported density (1.7/mi^2) over the entire state]. Considering that mink are essentially aquatic, another estimate can be made using information on densities in differing wetland habitats. A conservative estimate would be 2.5 mink per mile of perennial stream and 8.5/mi^2 of lakes and other perennial impoundments (the lowest reported densities). Colorado has approximately 31,470 miles of perennial (year-round) rivers and streams, and 260 mi^2 in perennial bodies of water including the larger reservoirs and lakes (D. Litke, USGS, pers. comm. 2001). Colorado has many more wetlands that would likely support mink, so these numbers are very conservative. With these conservative assumptions, the mink population is estimated to be about 80,000, a similar estimate to that derived above.

Historic sportsman harvest has been estimated at 324 mink annually, but in recent years sportsman harvest has been much lower: 8 mink per year (CPW 2016a). Damage from mink is usually associated with poultry and fish predation, but WS-Colorado has not recorded any damage from mink in FY12-16. Long-term sustainable harvest rates for mink were reported by Banci and Proulx (1999) to be between 30% and 50%. For this analysis, we will use the low end of that range: 30%.

<u>Direct Impacts</u>: WS-Colorado did not take any mink during FY12-16. Under Alternative 1, it is unlikely that WS-Colorado would take any mink, but it is possible that an occasional mink may be taken, up to 2 mink in any year. This represents less than 0.01% of the estimated mink population, which is expected to result in no impact to mink, either locally or statewide.

<u>Indirect Impacts</u>: We are not aware of any significant indirect impacts to mink due to PDM conducted by WS-Colorado. The infrequent take under Alternative 1 would be unlikely to affect immigration rates or distances, fecundity, or age structure.

<u>Cumulative Impacts</u>: The hunting and trapping seasons were closed in 1995, but re-opened in 2006. Sportsman harvest was estimated at zero in 2006-07, and 15 in 2009-10 (CPW 2016a). No other estimates are available since the season was closed in 1995. The average sportsman harvest based on these data is 8 per year (Table 3-2). There was no other known means of take for mink, so these numbers reflect cumulative take also. Under Alternative 1, cumulative take of mink is anticipated to remain below 150 mink in any year. This is considerably higher than the current cumulative take; such an increase would be almost entirely due to potential increased sportsman harvest. Such cumulative harvest rates under Alternative 1 (less than 0.2% of the mink population) would be below the historic sportsman harvest rate of 0.3%, and well below the estimated sustainable harvest threshold of 30%. This level of take would be expected to result in negligible impacts to local mink populations, and no impact to the statewide population. A summary of this impact analysis is provided in Table 3-2.

American mink populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.19 Impacts to Ringtail Populations:

Ringtails (*Bassariscus astutus*) are managed as furbearers by CPW. They are found in most of southern and western Colorado at lower elevations in about 60% of the State. Ringtails occupy rimrock, desert, and rocky ridge habitats in close association with water, and feed on small mammals, birds, lizards, insects, and mast (Armstrong *et al.* 2011). Historic sportsman harvest in Colorado has been estimated at 168 ringtails, but harvest has been much lower in recent years: 28 per year on average (CPW 2016a).

Published ringtail densities vary greatly from 0.2/mi^2 to 51.8/mi^2, which likely reflects differing habitat suitability. However, many of these were determined prior to 1950, when densities may have been different. Estimates from a Utah study in the late 1970s, with habitat similar to some areas in Colorado where ringtails occur, were reported as 3.9-7.5/mi^2 (Kaufmann 1999). Using the lowest reported density estimate of 0.2/mi^2, Colorado would have an estimated 12,500 ringtails which is likely very conservative. Because of their habitat choice and secretive nature, ringtails seldom become a problem, but have been known to become a nuisance in and around human habitations.

No long-term sustainable harvest rate has been determined for ringtails, so we will use the lowest reported sustainable harvest rate for any species analyzed in this EA, 10%, as a conservative estimate. Historic harvest levels in Colorado prior to the 1995 closure of the hunting/trapping season averaged 168 per year (1.3% of the estimated population), with a maximum of 292 (2.3% of the estimated population) (CPW 2016a).

<u>Direct Impacts</u>: WS-Colorado did not take any ringtails during FY12-16. Under Alternative 1, we anticipate the take of ringtails by WS-Colorado to be unlikely, but possible, with a maximum of 2 ringtail in any year. This represents less than 0.02% of the statewide ringtail population. This level of take would result in a negligible impact to ringtail locally, and no impact to the overall ringtail population.

<u>Indirect Impacts</u>: We are not aware of any significant indirect impacts of PDM conducted by WS-Colorado on ringtails. The infrequent take under Alternative 1 would be unlikely to affect immigration rates or distances, fecundity, or age structure.

<u>Cumulative Impacts</u>: The hunting and trapping seasons were closed in 1995, but re-opened in 2009. Recent sportsman harvest averaged 28 per year during, with a range of zero to 74, based on the only three estimates available (2009-10, 2011-12, and 2012-13; CPW 2016a). There was no other known means of take for ringtails, so these numbers reflect cumulative take also. Average cumulative take was 0.2%, with a maximum of 0.6% of the estimated statewide ringtail population. Under Alternative 1, we expect that the cumulative take of ringtails would not exceed 150. This comprises only 1.2% of the estimated ringtail population. It is also comprised almost entirely of hunter harvest, which WS-Colorado has no control over. This level of take is lower than historic levels, and much lower than the conservative sustainable harvest threshold of 10%. This level of take would be expected to have a negligible impact on ringtails locally, and no impact on the statewide ringtail population. A summary of this analysis is provided in Table 3-2.

Range-wide ringtail population trends are unknown, but they are listed as a species of "least concern" according to the IUCN (2017).

3.1.1.20 Impacts to Wolf Populations:

There is currently no known population of gray wolves in Colorado. However, there are populations in neighboring states. Dispersals into Colorado have been documented, and these animals could produce a breeding population in Colorado at some point in the future. As such, gray wolves might cause damage in Colorado in the future, especially to livestock. Under Alternative 1, WS-Colorado would conduct various non-lethal methods to manage such damage, as discussed in Section 2.11. Lethal PDM for gray wolves would not be conducted, except under separate NEPA analysis which might be conducted in the future by federal land managers, the USFWS, or WS-Colorado.

Direct, Indirect, and Cumulative Impacts: WS-Colorado PDM under Alternative 1 would not result in any lethal take of wolves. As such, there would be no significant direct or indirect impacts to wolves. WS-Colorado would likewise not contribute to any significant cumulative impacts on wolves under Alternative 1.

3.1.1.21 Summary of Direct, Indirect, and Cumulative Impacts to target wildlife populations Under Alternative 1:

Direct Impacts: Lethal take of target predators by WS-Colorado for PDM is consistently only a very small percentage of their estimated statewide populations (Table 3-2), and we anticipate similar levels of take under Alternative 1, which would result in no direct impact to their statewide populations. Under Alternative 1, we anticipate the following WS-Colorado PDM take of target mammalian predator species:

- less than 0.1% of most predator species, including striped skunk, badger, opossum, bobcat, swift fox, gray fox, western spotted skunk, long-tailed weasel, short-tailed weasel, marten, mink, and ringtail;
- less than 0.2% of the populations of raccoon and red fox;
- less than 0.8% of the population of mountain lions;
- less than 1.2% of the population of black bears; and
- less than 2% of the population of coyotes.

WS-Colorado PDM activities under Alternative 1 may result in short-term, temporary impacts to localized coyote, black bear, and mountain lion populations, which is often the goal of PDM. These impacts are not considered to be "significant" as defined by NEPA and CEQ, because they are localized and temporary, and because they will have no impact on statewide populations. Any impacts on feral cats, dogs, and ferrets would be beneficial, because they are not indigenous parts of the ecosystem in Colorado.

Indirect impacts: These might include increased localized immigration rates and distances, and increased fecundity for coyotes, black bear, and mountain lions, in locations where WS-Colorado might temporarily decrease local populations. There might also be a younger age structure in local coyote populations in locations where WS-Colorado conducts the most PDM. These impacts would not significantly impact the overall populations of these predator species. Other target predator species are unlikely to be indirectly impacted. We are not aware of any other indirect impacts to target wildlife species due to PDM conducted by WS-Colorado.

Cumulative Impacts: Native mammalian predators are managed by CPW on a sustainable basis, and the largest contributor to cumulative take for these target predator species is sportsman harvest. WS-Colorado PDM take is a very minor component of cumulative take for all species analyzed. The cumulative harvest of all predator species is below long-term sustainable harvest rates, and for most species, substantially below these rates. As such, there would be no significant cumulative impacts to target predator species populations under Alternative 1 (Table 3-2).

3.1.2 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS-Colorado take of most target predator species would be about the same as that under Alternative 1, because WS-Colorado does not conduct preventive PDM for any of the predator species in this EA, except coyotes. Damage from all other predator species is of relatively low occurrence, and temporally and spatially unpredictable. For all species except coyotes, WS-Colorado PDM actions are corrective in nature, so the impacts under Alternative 2 would not be different from those under Alternative 1.

The exception is coyotes; the current WS-Colorado PDM program uses preventive PDM for coyotes because some coyote damage is predictable based on prior damage and/or the appropriate conditions for damage. Fewer coyotes would be killed by WS-Colorado if we were to wait for livestock to be killed before responding to assist. For some coyote damage situations, this alternative would be similar to Alternative 1 because many producers do not contact WS-Colorado until damage has already occurred, or after they have already attempted non-lethal methods. Preventive control is currently used most often in cattle and sheep production areas which have had historical damage from coyotes. Even with preventive nonlethal methods in use, preventive aerial PDM has been shown to reduce sheep and lamb losses later in the year, compared to sites without (Gantz 1990, Wagner and Conover 1999).

The take of target predators by private individuals or nuisance wildlife control companies would likely increase, because producers who anticipate damage would not be likely to wait for the damage to occur. This would be especially true for producers who had suffered historic damage. They would be more likely to take preventive lethal PDM actions on their own, or to contract these services, in an effort to prevent the expected damage. This increased take of predators by private individuals or companies would partially offset the decreased take by WS-Colorado. Much of the WS-Colorado preventive coyote take is by aerial PDM. Whereas private aerial PDM would be expected to increase under this alternative, it would not be likely to result in the same amount of coyote take as under Alternative 1, because relatively few private entities would be likely to provide this service, and because these private entities would not be permitted to conduct aerial PDM on federal public lands, which comprised approximately 12% of the WS-Colorado total coyote take during FY12-16. The end result under Alternative 2 would be approximately 10% lower take of coyotes for PDM, or about 200 fewer coyotes per year. Under this Alternative, maximum likely cumulative take of coyotes would be approximately 47,138, compared to 47,338 under Alternative 1, which is 0.4% lower.

Whereas coyote take would be lower under this alternative, the impact of direct, indirect, and cumulative take under Alternative 2 would be the same as those under Alternative 1. Under Alternative 2, there would be no impact on statewide populations of target predator species.

3.1.3 Alternative 3 – WS-Colorado Provides Technical Assistance Only.

Direct Impacts: Under this alternative, WS-Colorado would only provide advice or guidance on PDM techniques and methods. WS-Colorado would not conduct any direct operational PDM in attempting to resolve damage complaints. Therefore, WS-Colorado would have no direct impacts on predator populations in Colorado. Whereas predator take by WS-Colorado would be substantially lower (zero) under this Alternative, the direct impacts of WS-Colorado PDM would not be significantly different from those under Alternative 1, because there would be no impact to any statewide target predator population under either alternative.

Indirect Impacts: Indirect impacts from WS-Colorado activities would be the same under this alternative as for Alternative 1; there would be no significant indirect impacts on target predator species. Indirect impacts due to the increased take by other entities would likely increase due to the increased take by these entities, but impacts are not likely to be significant. As such, there would be no measurable difference from Alternative 1.

Cumulative Impacts: PDM has been shown to be effective in limiting losses due to predators (Nass 1977, 1980; Howard and Shaw 1978; Howard and Booth 1981; O'Gara *et al.* 1983; Gantz 1990; Wagner and Conover 1999). As such, under Alternative 3, producers would either suffer higher losses, which would be passed on to consumers, or other entities would conduct PDM to some degree to compensate for the reduction in federal services. The latter is more likely, and might include state agencies (CDA and CPW), and private entities or organizations. If such entities did not effectively respond to damage complaints, some affected individuals might become intolerant of such damaging wildlife species (International Association of Fish and Wildlife Agencies 2004), and such intolerance would likely increase direct, indirect, and cumulative impacts to some degree. Private individuals, companies, state agencies, and perhaps local governments would continue to take predators for PDM, and that level of take would increase under this alternative. We anticipate three scenarios: (1) those who would continue to request technical assistance from WS-Colorado, (2) those who would no longer request assistance from WS-Colorado, and (3) those who do not currently request assistance from WS-Colorado.

In the first scenario, WS-Colorado would likely recommend lethal PDM in all instances where it would be prudent and effective. As such, among those who continued to seek technical assistance from WS-Colorado, similar levels of lethal PDM would likely be attempted. This lethal PDM would be conducted by private individuals or companies, as well as state agencies, and perhaps local governments. The total number of predators taken would likely be lower, because these entities and individuals would likely be less efficient at removing problem animals than WS-Colorado employees. Some individuals may be as efficient, but due to the higher number of individuals conducting PDM, not all can be expected to reach this level of efficiency due to a relative lack of experience.

In the second scenario under Alternative 3, there will likely be individuals, companies, and organizations who no longer look to WS-Colorado for assistance with PDM. Most of them would be highly likely to conduct lethal PDM on their own, or to contract these services. This would likely result in a slight decrease in predator take compared to Alternative 1, due to the relative inexperience of those involved.

For the third scenario under Alternative 3, take of predators for PDM by private individuals who currently do not request assistance from WS-Colorado would not likely change; they would continue to take predators in similar numbers as under Alternative 1, mainly to protect agriculture.

Under Alternative 3, coyote take for PDM would likely be 20% lower for coyotes. This incorporates the reasons for lower PDM take discussed under Alternative 2. In addition, most private entities conducting PDM limit their work to within ½ mile of roads, whereas most coyotes taken by WS-Colorado are taken greater than ½ miles from a road. PDM take would likely be 10-20% lower for red fox; and 20-40% lower for raccoons, striped skunks, American badgers, black bears, and mountain lions. For all other target predator species, PDM take would likely be about the same as under Alternative 1, because very little PDM is conducted for these species. In some cases, additional black bears and mountain lions would likely be taken by private entities who would be less likely to target the offending animals due to lower levels of experience, training, and oversight.

The cumulative harvest of these target predator species under Alternative 3 would likely be negligibly lower (<1%) for all species except black bears and mountain lions, because the vast majority of cumulative take for these species is sportsman harvest, which would not differ among the alternatives. Because CPW intensively manages black bears and mountain lions, cumulative take for these species would be virtually identical to that under Alternative 1; CPW would continue to manage these species for cumulative take, according to their targets.

Under Alternative 3, the cumulative impacts on target predator species' populations would not differ from those analyzed under Alternative 1; statewide target predator populations would not be impacted.

3.1.4 Alternative 4 – No PDM by WS-Colorado.

Direct Impacts: Under this alternative, WS-Colorado would not provide assistance with PDM, so there would be no direct impact by WS-Colorado on target predator populations in Colorado. The take of these predator species by WS-Colorado would be lower than under Alternative 1, but the overall direct impacts would not change; there would be no impacts to target predator species' populations under this alternative.

Indirect Impacts: Indirect impacts from WS-Colorado activities would be the same under this alternative as for Alternative 1; there would be no significant indirect impacts on target predator species. Indirect impacts due to the increased take by other entities would likely increase due to the increased take by these entities, but impacts are not likely to be significant. As such, there would be no measurable difference from Alternative 1.

Cumulative Impacts: As discussed under Alternative 3, PDM has been shown to be effective in limiting losses due to predators (Nass 1977, 1980; Howard and Shaw 1978; Howard and Booth 1981; O'Gara et al. 1983; Gantz 1990; Wagner and Conover 1999), and state agencies (CDA and CPW) and private entities would increase lethal PDM accordingly. If such entities did not effectively respond to damage complaints, some affected individuals might become intolerant of such damaging wildlife species (International Association of Fish and Wildlife Agencies 2004), and such intolerance would likely increase direct, indirect, and cumulative impacts to some degree.

Under Alternative 4, target predator species take for PDM would likely be somewhere between that of Alternative 1 and Alternative 3 for most species. Under Alternative 4 WS-Colorado would not be available to provide technical assistance, which might otherwise help some private entities to be more successful in their attempts at lethal PDM. Also, we would expect approximately 12% fewer coyotes taken for PDM on federal lands by aerial PDM. However, the lack of non-lethal technical assistance from WS-Colorado which would be available under Alternative 3 would likely result in increases in lethal PDM by private entities who lack the ability, knowledge, and professionalism to incorporate an effective integrated approach. The cumulative harvest of these target predator species under Alternative 4 would likely be negligibly lower (<1%), or about the same as that analyzed under Alternative 1.

The cumulative impacts to target predator species' populations in Colorado under Alternative 4 would be the same as that for Alternative 1, 2, and 3; there would be no impact to statewide target predator species' populations.

3.2 Issue B: Impacts on Populations of Non-target Species

Non-target species can be impacted by PDM whether implemented by WS-Colorado, other agencies, or the public. Impacts can range from direct take while implementing PDM methods to indirect impacts resulting from the reduction of predators in a given area, or indirect impacts caused by specific PDM activities. Protective measures are often incorporated into PDM to reduce impacts to non-target species. Various factors may, at times, preclude the reasonable use of certain methods, so it is important to maintain the widest possible selection of PDM tools for resolving predator damage problems, and assess all non-target concerns. The use of legal and biologically sound PDM methods, along with protective measures, can minimize impacts to non-target species. Following is an analysis of the potential impacts to non-target species under Alternatives 1-4.

3.2.1 Alternative 1 – Proposed Action/No Action Alternative—Continue WS-Colorado PDM Program.

During FY12-16, WS-Colorado took 13 different non-target species during PDM, averaging 7 animals per year (Table 3-13). Of the 42 total non-target animals WS-Colorado took during FY12-16, only 14 of them (0.1% of total predator take) were taken lethally (average of <3 animals taken lethally per year). The other 28 animals were freed. The capture and release of these animals constitutes nonlethal take, which is not likely to impact the populations of these species. Most non-target species taken during PDM (7 of 13 species, and 21 of 42 animals) were other mammalian predator species which were not targeted during a specific operation, or were not the specific individual targeted, but were on the cooperative agreement as a target species. Impacts on these target predator species were discussed in Section 3.1, and the lethal non-target take listed here was included in the total WS-Colorado take analyzed for each target species. Nonlethal take of these target species would not affect the species' populations. The potential impacts of nonlethal take is limited to impacts on individual animals, which is discussed in Issue F (Other Socioeconomic Issues) under humaneness and ethics.

Other than target mammalian predators, non-target take during FY12-16 included one domestic dog, one porcupine (*Erethizon dorsatum*), three desert cottontails (*Sylvilagus audubonii*), three common ravens (*Corvus corax*), 12 black-billed magpies (*Pica hudsonia*), and one mourning dove (*Zenaida macroura*). The dog, the cottontails, the mourning dove, and 11 of the 12 magpies were released alive and unharmed. The dog is discussed under Public Safety and Pets.

Table 3-13. All nontarget animals taken by WS-Colorado during PDM from FY12 through FY16 on all land classes in Colorado.

		Total FY12-FY16		Average FY12-FY16	
Group	**Species**	**Killed**	**Freed**	**Killed**	**Freed**
Target Mammalian Predators	Badger	0	0	0	0
	Feral Cat	0	11	0	2
	Red Fox	2	0	0	0
	Swift Fox	2	0	0	0
	Mink	0	1	0	0
	Raccoon	2	0	0	0
	Striped Skunk	3	0	1	0
Other Mammals	Domestic Dog	0	1	0	0
	Porcupine	1	0	0	0
	Desert Cottontail	0	3	0	1
Birds	Common Raven	3	0	1	0
	Black-billed Magpie	1	11	0	2
	Mourning Dove	0	1	0	0
All	**Total[a]**	**14**	**28**	**2**	**5**

[a]Totals may not exactly match the numbers due to rounding.

Porcupines are found throughout Colorado (Armstrong *et al.* 2011, Rose and Ilse 2003), and are locally abundant in many areas. Their worldwide population trend is stable, and they are listed as a species of "least concern" according to the IUCN (2017). The non-target take of one porcupine over the course of five years is negligible and will have no impact on the porcupine population.

Desert cottontails are widely distributed throughout eastern and western Colorado (Armstrong *et al.*, 2011), and are known to cause problems. For example, cottontails attract raptors to airports, which threaten public safety and property. In 2014-15, Colorado sportsmen harvested an estimated 54,083 cottontails (eastern, desert, and mountain cottontails combined; CPW 2017a). Their worldwide population trend is stable, and they are listed as a species of "least concern" according to the IUCN (2017). Cottontails are abundant in Colorado, and the non-target take of three animals over five years is negligible, especially because the take was non-lethal.

Common ravens are abundant throughout much of Colorado, and their populations have increased significantly over the last 40 years (Coates *et al.* 2016, Coates and Delehanty 2010, Manzer and Hannon 2005). As a predatory bird species, they occasionally cause damage to agricultural and natural resources, and as such, they are targeted by WS-Colorado and non-federal entities for lethal control. During FY10-14, WS-Colorado lethally took 220 common ravens, as a target species, which is covered under a separate EA (WS 2013a). Their worldwide population trend is increasing, and they are listed as a species of "least concern" according to the IUCN (2017). The non-target take of three common ravens over five years is negligible compared to their abundance and targeted take.

Black-billed magpies are considered non-game wildlife in Colorado, but they can cause damage to agriculture. As such, they are included in the Federal "depredation order for blackbirds, cowbirds, crows, grackles, and magpies", which allows the control of these birds "*when found committing or about to commit depredations upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance*" (50 CFR 21.43). Their worldwide population trend is stable, and they are listed as a species of "least concern" according to the IUCN (2017). The lethal take of one magpie by WS-Colorado over 5 years is negligible compared to their population in Colorado, and their take under this depredation order. The other 11 magpies taken during FY12-16 were released on-site, alive and unharmed; such nonlethal take would not impact magpie populations.

Mourning doves are considered game species in Colorado, and CPW estimated that hunters took 389,137 mourning doves in 2011 (CPW 2017a). Their worldwide population trend is increasing, and they are listed as a species of "least concern" according to the IUCN (2017). The non-target take of one mourning dove by WS-Colorado is negligible compared to hunter harvest, especially since the WS-Colorado take was non-lethal, which would not affect the mourning dove population.

WS-Colorado PDM has the potential of capturing other non-target species as well. Species that are of similar or more weight and size as the targeted species can be accidentally taken with several of the PDM methods used. WS-Colorado protective measures (*e.g.*, pan-tension devices) have been effective in keeping non-target take low. These were discussed in Section 2.11. Future non-target take under Alternative 1 includes the infrequent take of the following non-target species which WS-Colorado has taken lethally during the last 14 years (FY04-17): badger, bobcat, feral cat, mule deer (*Odocoileus hemionus)*, feral dog, red fox, swift fox, black-tailed jackrabbit (*Lepus californicus*), great blue heron (*Ardea herodias*), black-billed magpie, muskrat (*Ondatra zibethicus*), porcupine, cottontail rabbit (*Sylvilagus sp.*), raccoon, common raven, striped skunk, fox squirrel (*Sciurus niger)*, 13-lined ground squirrel (*Ictidomys tridecemlineatus*), and woodchuck (*Marmota monax*). Table 3-14 summarizes the total and average take of these species over this 14-year period, which shows how infrequently WS-Colorado kills a non-target species.

The species in Table 3-14 are the non-target species most likely to be lethally taken by WS-Colorado during PDM under Alterative 1. Except for badgers, feral cats, and feral dogs, the worldwide population trends of these species are either stable or increasing, and they are listed as a species of "least concern" according to the IUCN (2017). These species are all relatively common in Colorado, either locally or statewide, and infrequent non-target take during PDM would not be expected to negatively affect their statewide populations.

Badgers were discussed in Section 3.1, and were determined not to be significantly impacted by WS-Colorado PDM, including occasional non-target take. Feral cats and feral dogs (also discussed in Section 3.1) are not native to North America, and the take of these species is generally considered to be a benefit to the environment.

Table 3-14. All nontarget animals lethally taken by WS-Colorado during PDM during the 14-year period from FY04 through FY17 on all land classes in Colorado.

Group	Species	Total FY04-FY17	Average FY04-FY17
Target Mammalian Predators	Badger	5	<1
	Bobcat	1	<<1
	Feral Cat	1	<<1
	Feral Dog	1	<<1
	Red Fox	13	1
	Swift Fox	11	1
	Raccoon	23	2
	Striped Skunk	8	1
Other Mammals	Mule Deer	1	<<1
	Porcupine	3	<1
	Jackrabbit	3	<1
	Cottontail	2	<<1
	Ground Squirrel	3	<1
	Fox Squirrel	2	<<1
	Woodchuck	2	<<1
	Muskrat	1	<<1
Birds	Common Raven	4	<1
	Great Blue Heron	1	<<1
	Black-billed Magpie	1	<<1
All	**Total**	**86**	**6**

Average take less than one reported as "<1" (less than one), or "<<1" (much less than one).

WS-Colorado uses hounds to capture depredating mountain lions and black bears, as discussed in Section 3.6.1. The risk of injury or death to non-target animals has been raised as a concern by commenters. As discussed in Section 3.6.1, WS-Colorado incorporates numerous measures to minimize the likelihood of injury or death to either the hounds or the target predators; these measures effectively reduce the likelihood of non-target impacts as well. For example, Grignolio *et al.* (2011) reported that hunting with hounds altered the behavior of non-target roe deer (*Capreolus*

capreolus) simply due to the presence of the hounds. However, these impacts were limited to avoidance behaviors. Sweeney *et al.* (1971) assessed the responses of white-tailed deer (*Odocoileus virginianus*) when actively chased by hounds several times per day. These researchers found that the deer used escape habitat and were easily chased out of their home ranges, results similar to those reported by Grignolio *et al.* (2011). However, Sweeney *et al.* (1971) found that the deer quickly returned to their home ranges after the chase; thus, the impacts of active hound chases were short-lived. Mori (2017) found that non-target crested porcupines (*Hystrix cristata*) increased their home range when hounds were used for hunting in the area. However, the porcupines showed a similar response to the presence of snow. Also, the study included the regular use of 20-40 dogs for hunts. WS-Colorado uses far fewer hounds (4-6 hounds; Section 3.6.1), conducts far fewer pursuits, and the hounds spend much less time in active pursuit. We do not anticipate any significant negative impacts to non-target wildlife which might be in the vicinity of hounds used to capture mountain lions or black bears under Alternative 1 due to the infrequency of pursuits, the short pursuit times, the spatial diversity of pursuits, the small number of hounds used, and the non-aggressive nature of the hounds. Moreover, the hounds used by WS-Colorado have been selected to track lions and bears; hounds breaking off to chase non-target wildlife is extremely rare. Under Alternative 1, we do not anticipate any significant non-target impacts due to the use of hounds.

Under Alternative 1, WS-Colorado might use two chemicals for lethal PDM: sodium cyanide (the active ingredient in M-44s) and carbon monoxide (the active ingredient in Large Gas Cartridges). These methods are discussed in detail in Appendix A. APHIS-WS has conducted risk analyses on the use of these methods (WS 2017i, 2017j). These risk analyses address threats to non-targets, secondary exposure risks, and groundwater contamination risks for each chemical. These risk analyses determined that risks to non-targets, secondary hazards, and the potential for groundwater contamination from these chemicals are low, and would not present any significant environmental hazard when used properly, and according to the EPA labels. WS-Colorado employees follow the EPA labels for the use of these chemicals; follow federal, state, and local laws and regulations; and incorporate numerous protective measures (Section 2.11) in order to minimize risks to non-target animals. Secondary exposure of predators and scavengers to sodium cyanide, the active ingredient in M-44s (EPA Reg. No. 56228-15), is unlikely, because the chemical is quickly converted to hydrogen cyanide gas upon discharge, which is quickly metabolized in the target animal (WS 2017i, Bhandari *et al.* 2014, EPA 1994). Secondary exposure of predators or scavengers to carbon monoxide, the effective agent released by Large Gas Cartridges (EPA Reg. No. 56228-21), is unlikely because carbon monoxide dissipates from carcasses rapidly, does not persist in the target organism, and does not bio-accumulate (WS 2017j). In addition, the carcasses of most target species taken with large gas cartridges remain underground in their burrows where they are inaccessible to scavengers (WS 2017j).

WS-Colorado does not anticipate any substantial increase in non-target take under Alternative 1. This may include the infrequent non-lethal and lethal take of a carnivore, rodent, lagomorph, or bird. Other than T&E species, and other species of concern as discussed below, we anticipate that these levels of take would result in no significant impacts to the statewide populations of non-target species.

3.2.1.1 Effects on listed threatened and endangered species.

WS-Colorado consulted with the USFWS on potential impacts of PDM activities on federal listed threatened and endangered species, including critical habitat (Biological Assessment dated July 29, 2016; Appendix C). The USFWS concurred with WS-Colorado's analysis and mitigation measures to avoid impacting threatened and endangered species (WS 2016b; Appendix D). The WS-Colorado program has a track record of consulting with the USFWS since 1992 to avoid harm to federal listed threatened and endangered species. No threatened or endangered species have been harmed or taken by WS-Colorado since the transfer from the USFWS to USDA in 1986. We are unaware of whether any such harm or take occurred before then. Additionally, WS-Colorado has played important roles in assisting with the recovery of federally listed threatened and endangered wildlife in Colorado, including black-footed ferrets, Gunnison sage-grouse, piping plover, least tern, Colorado River cutthroat trout, Colorado pikeminnow, humpback chub, bonytail chub and razorback sucker.

Protective measures to avoid T&E impacts were described in Chapter 2. Those measures should ensure that the proposed action (Alternative 1) will not have adverse effects on T&E species. Of the federal and state listed species occurring in Colorado, PDM has the potential to adversely affect certain terrestrial vertebrate species (mammals and birds), as discussed below. Eleven T&E species could be adversely affected by PDM activities, whereas 9 T&E species could benefit.

WS-Colorado PDM will have no effect on any of Colorado's T&E fish and amphibian species because PDM methods will not affect water or wetlands, and PDM activities are not generally conducted in aquatic or wetland environments. This includes greenback cutthroat trout, Colorado pikeminnow, humpback chub, bonytail chub, and razorback sucker.

Colorado does not have any reptile species listed. WS-Colorado PDM will have no effect on any of Colorado's T&E plant and invertebrate species because PDM activities do not modify or impact habitat to any extent, and PDM activities are not generally conducted in these species' habitats. Moreover, WS-Colorado follows protective measures (as discussed in Chapter 2) to minimize or eliminate any the potential impact to these species. This includes the following plant species: Mancos milk-vetch, Osterhout milk-vetch, clay-loving wild buckwheat, Penland alpine fen mustard, Colorado butterfly plant, Pagosa skyrocket, Dudley

Bluffs bladderpod, Knowlton cactus, Parachute beardtongue, Penland beardtongue, North Park phacelia, DeBeque phacelia, Dudley Bluffs twinpod, Colorado hookless cactus, Mesa Verde cactus, and Ute ladies'-tresses. This also includes the following invertebrate species: Uncompahgre fritillary butterfly and Pawnee montane skipper. Information on federal listed threatened and endangered species is presented in Table 3-15a. USFWS and CPW monitor several species considered threatened, endangered, or sensitive in Colorado. These agencies monitor these species' populations to determine if different activities singly or combined are impacting the populations (*i.e.*, a cumulative impact analysis). Mortality for T&E species is monitored where feasible. But mortalities due to road kills, loss of habitat (*e.g.*, land development, construction, housing, industrial complexes, road, mining, and oil and gas development), and natural disasters (*e.g.*, fires, floods, lightning, heavy winters, and drought) are the same under all alternatives and much of this activity that results in mortality or population limiting factors is difficult to determine. These factors are not likely to be determined sufficiently even with unlimited funding; they can only be estimated based on population trends (increasing, decreasing, or stable). The availability of habitat is often the most critical concern because the available habitat determines the population which an area can support. WS-Colorado consults with CPW and USFWS, as necessary, to provide them with information regarding WS-Colorado's potential to take these species with PDM methods. WS-Colorado has determined that one or more PDM activities have the potential to adversely affect 11 T&E species (not including 2 species considered extirpated).

Table 3-15a. Federal threatened and endangered species in Colorado, and the potential for Wildlife Services predator damage management (PDM) activities to impact these species.

Common Name	Scientific Name	Status	Location in Colorado	Habitat	PDM Impacts
MAMMALS					
Preble's Meadow Jumping Mouse	*Zapus hudsonius preblei*	Threatened	North-central, Central	Riparian/ Grassland Edge	None
New Mexico Meadow Jumping Mouse	*Zapus hudsonicus luteus*	Endangered	South	Riparian, Wetland	None
Black-footed Ferret	*Mustela nigripes*	Endangered	Eastern Plains, Mountain Parks, Western Valleys	Grasslands, Shrublands	Positive, Negative
Canada Lynx	*Lynx canadensis*	Threatened	West, Central Mountains	Subalpine	Positive, Negative
Grizzly Bear	*Ursus arctos*	Threatened	No Extant Population	Various	None
Gray Wolf	*Canis lupus*	Endangered	No Extant Population	Various	
BIRDS					
Gunnison Sage-Grouse	*Centrocercus minimus*	Threatened	Central-Westcentral	Sagebrush and Riparian	Positive, Negative
Lesser Prairie-chicken	*Tympanuchus pallidicintus*	Threatened	Southeast	Grasslands	Positive
Whooping Crane	*Grus americana*	Endangered	No Extant Population	Mudflats, Wetlands	None
Piping Plover	*Charadrius melodus*	Threatened	Eastern Plains	Sandy Beaches, Wetlands	Positive, Negative
Least Tern (Interior Population)	*Sterna antillarum*	Endangered	Southeast	Sandy Beaches, Wetlands	Positive, Negative
Yellow-billed Cuckoo (Western pop.)	*Coccyzus americanus*	Threatened	West	Woodlands, Shrublands	None
Mexican Spotted Owl	*Strix occidentalis lucida*	Threatened	Central, West	Mature forests	None
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Southwest, South-central	Forest, Riparian	Positive, Negative
FISHES					
Greenback CutthroatTrout	*Oncorhynchus clarki stomias*	Threatened	South Platte River System	Rivers	None
Colorado Pikeminnow	*Ptychocheilus Lucius*	Endangered	Upper Colorado River Basin	Rivers	None
Humpback Chub	*Gila cypha*	Endangered	Colorado River System	Rivers	None
Bonytail Chub	*Gila elegans*	Endangered	Yampa, Green, Colorado, and Gunnison Rivers	Rivers	None
Razorback Sucker	*Xyrauchen texanus*	Endangered	Colorado River System	Rivers	None
INVERTEBRATES					
Uncompahgre Fritillary Butterfly	*Boloria acrocnema*	Endangered	Central, Southwest	Alpine	None
Pawnee Montane Skipper	*Pseudocopaeodes eunus obscurus*	Threatened	Douglas/El Paso/ Jefferson/ Park/Teller Counties	Sparse woodlands	None
PLANTS					

Mancos Milk-vetch	*Astragalus humillimus*	Endangered	Montezuma County	Exfoliating Sandstone	None
Osterhout Milk-vetch	*Astragalus osterhoutii*	Endangered	Grand County	Barren Shale	None
Clay-loving Wild Buckwheat	*Eriogonum pelinophilum*	Endangered	Delta/ Montrose	Dry, Alkaline, Sparse Shale	None
Penland Alpine Fen Mustard	*Eutrema penlandii*	Threatened	Lake/Park/ Summit Counties	Fens	None
Colorado Butterfly Plant	*Gaura neomexicana coloradensis*	Threatened	North Central	Riparian/Wetland	None
Pagosa Skyrocket	*Ipomopsis polyantha*	Endangered	Archuleta County	Forests, Grasslands	None
Dudley Bluffs Bladderpod	*Lesquerella congesta*	Threatened	Rio Blanco County	Riparian, shale outcrops	None
Knowlton Cactus	*Pediocactus knowltonii*	Endangered	La Plata County	Grassland/Shrubland/woodland	None
Parachute Beardtongue	*Penstemon debilis*	Threatened	Garfield County	Steep talus slopes	None
Penland Beardtongue	*Penstemon penlandii*	Endangered	Grand	Shrubby grassland	None
North Park Phacelia	*Phacelia formolusa*	Endangered	Jackson/ Larimer	Eroded Barren Soils	None
DeBeque Phacelia	*Phacelia submutica*	Threatened	Garfield/ Mesa Counties	Steep Clay Soils	None
Dudley Bluffs Twinpod	*Physaria obcordata*	Threatened	Rio Blanco County	Steep Riparian Slopes	None
Colorado Hookless Cactus	*Sclerocactus glaucus*	Threatened	Delta/ Garfield/ Mesa/ Montrose Counties	Riparian	None
Mesa Verde Cactus	*Sclerocactus mesae-verdae*	Threatened	Montezuma	Desert	None
Ute Ladies'-tresses	*Spiranthes diluvialis*	Threatened	East, Central, Southwest	Riparian/Wetland	None

Black-footed Ferret. In Colorado, black-footed ferrets are federally listed as a nonessential experimental population. The black-footed ferret was recently reintroduced into eastern Colorado, beginning in 2013, and reestablished populations are now known to exist at various reintroduction sites in southeast and Colorado and along the Front Range, from Denver to Wyoming. WS-Colorado PDM methods including foothold traps and gas cartridges have the potential for taking ferrets. The label for the M-44 does not allow its use in prairie dog towns in order to preclude incidental take of black-footed ferrets; thus M-44's are expected to have no effect on the ferret. WS-Colorado coordinates with the USFWS to conserve black-footed ferrets. This is accomplished by following conditions in Safe Harbor Agreements. Additionally, WS-Colorado uses pan-tension devices which preclude capture of the ferrets when working in or near prairie dog colonies. WS-Colorado has worked with USFWS by conducting PDM to reduce predation on ferrets. In one of the first releases in Moffat County, CO in 2001, 34 of the 39 ferrets released were killed by predators. It was found that controlling predators in the area prior to the release helped get their population established in subsequent releases. WS-Colorado has not taken any black-footed ferrets. Additionally, WS-Colorado has aided the reintroduction of black-footed ferrets across the prairie in eastern Colorado by treating black-tailed prairie dog colonies to kill fleas and prevent the spread of sylvatic plague, and is currently working to implement sylvatic plague vaccine to further protect the ferrets. The risk from plague can result in the loss of prairie dogs which make up 80% of the ferrets' diet. Death of ferrets from plague, and loss of the ferrets' food supply leads to failure of reintroduction efforts.

Kit fox. Kit fox are listed by the State of Colorado as endangered. Colorado is on the eastern part of their range in the U.S. Several tools used in PDM have the potential for taking a kit fox;

however, CPW has regulations that, when implemented, minimize the potential for WS-Colorado Specialists to take one. WS-Colorado follows these regulations, as discussed in Chapter 2 under protective measures. For example, WS-Colorado avoids using lethal methods where kit fox are known to exist. WS-Colorado also uses pan-tension devices on foothold traps and stops on snares to exclude kit fox from take. The minimum closure size for a body snare loop is 8-inches in diameter which would allow a kit fox to avoid capture. None were taken by WS-Colorado during FY12-16. Nationally, a few kit fox have been taken as target species in the past, which indicates that they can cause damage. However, kit fox are listed as Endangered by the State of Colorado, and as such, WS-Colorado does not target kit fox for lethal removal. They also cause very few complaints or damage in Colorado due to their low numbers. During the period from 1987 to 1994, an average of 13 were harvested annually (CPW 2016a), but in 1995, the season on kit fox was closed, and it remains so. These harvest figures illustrate that the population can sustain some low level of harvest without detriment to the population. Limited distribution in Colorado, habitat loss, and predation likely contribute to their low population. WS-Colorado will not target kit fox in Colorado due to their protected status and low population in Colorado, and under Alternative 1, incidental take is unlikely.

Canada Lynx. Canada lynx are federally listed as threatened. The Canada lynx occurs in the boreal forests of North America where it is highly associated with its primary prey, the snowshoe hare (*Lepus americanus*). The species is abundant and common in Canada and Alaska, where the core of its range occurs. Suitable lynx habitat consists of montane and subalpine forest ecosystems. At one time, lynx occurred in several states, including Colorado. The lynx became endangered under state law in Colorado in 1973, which is the last year that a lynx was documented to be taken in Colorado. There is no fur trapping for lynx in Colorado. USFWS federally listed the Canada lynx as threatened in its historic range in the lower 48 contiguous states in 2000. Colorado represents the extreme southern edge of its range.

In coordination with several other agencies and organizations, CPW began a reintroduction program in 1999 using lynx that were captured in Alaska and Canada and brought into the State. The entities involved in the reintroduction program determined the ideal location for a "Canada Lynx Recovery Area" in Colorado was in the southwestern part of the State. Reproduction was confirmed for the first time in 2003 with 16 kittens being found by CPW and 36 more kittens in 2004 (Shenk 2004). Lynx are now (2016) believed distributed above 9,000 feet elevation where spruce-fir forests and adequate snowshoe hare populations exist in southwestern and central Colorado. They also occur in lodgepole pine and aspen habitat in the Sawatch Range of central Colorado and the Medicine Bow and Front Range of northern Colorado (Ivan *et al.* 2011).

Lynx can potentially be both negatively and positively affected by PDM. WS nationally has only taken 1 non-target lynx. That lynx was taken by the Idaho WS Program in 1991 in non-lynx habitat and was released alive. In that same time frame, WS nationally took 74,419 target coyotes (average = 2,481/year) and 3,142 target bobcats (average = 105/year) in foothold traps. Because lynx occupy high elevation spruce-fir habitats rarely utilized by livestock, it is extremely unlikely that WS-Colorado would impact lynx using these methods. WS has never taken a lynx accidentally in Colorado and we consider the risk of take to be highly unlikely under current circumstances in the State. WS has intentionally captured lynx in Colorado as part of the reintroduction effort. Lynx have expanded their range in Colorado in spite of other wildlife that may compete with lynx for snowshoe hares and other food resources.

PDM methods that have the greatest probability of incidental take include foothold traps and snares, and, to a lesser extent, M-44s and trailing dogs. WS-Colorado abides by the August 23, 2005 BO from the USFWS (2009) which authorizes incidental take and established reasonable and prudent measures and terms and conditions to minimize the risk of take. WS has not taken a lynx in Colorado with the exception of one in response to a request from CPW officials to live-capture and translocate a lynx that had left lynx habitat and was found in a desert wash west of Grand Junction. The lynx was captured by WS-Colorado (acting as an agent for CPW) under CPW's USFWS permit. Trailing dogs treed the lynx, and it was immobilized, rehabilitated (it had become emaciated), and transported by CPW personnel back to lynx habitat. Currently, the lynx population in Colorado has been expanding its range and increasing as a result of natural reproduction. Mortalities can be attributed to lynx being shot, killed on highways, and other factors, and are closely monitored by CPW and USFWS. Thus far, WS-Colorado has not added to any mortality and, based on the experience of the WS-Colorado program over many years, we believe WS-Colorado PDM is not likely to result in take that would adversely affect lynx recovery in the State.

Some commenters have expressed a concern that WS-Colorado PDM activity might contribute in some substantive way to what might be significant cumulative impacts on lynx because of other actions unrelated or unconnected to WS-Colorado PDM, examples of which include oil and gas development, timber harvesting, residential subdivision development, and grazing. USFWS evaluated and considered future cumulative effects in the BO (USFWS 2009) of other types of activities such as residential and commercial development, recreational activities such as snowshoeing and snowmobiling, agricultural development, and livestock grazing, and concluded that the potential effects of WS-Colorado PDM actions in the State when combined with these other activities would not pose jeopardy to the continued existence of lynx. Therefore, we find no evidence that WS-Colorado PDM would add to any significant cumulative threat to lynx conservation in the State.

The USFWS has previously determined that timber harvesting could be a threat to lynx, but could also be beneficial depending on harvest methods, spatial and temporal specifications, and the inherent vegetation potential of the site. Forest practices in lynx habitat that result in or retain a dense understory provide good snowshoe hare habitat that in turn provides good foraging habitat for lynx (FR 68 40076 - 40101, July 3, 2003). Regarding effects of other types of activities, the USFWS determined that roads and trails, agricultural and urban development, off-road-vehicle and snowmobile use, ski resort expansion, mining, fire suppression, and grazing could also adversely affect lynx. They found that the threat to lynx by some of these activities, such as fire suppression, is low, and also found no evidence that some activities, such as forest roads, pose a threat to lynx. Some of the activities considered, such as mining and grazing, were not specifically addressed because they had no information to indicate they pose threats to lynx.

Most suitable lynx habitat in the Colorado is on USFS lands, with lesser amounts occurring on lands under BLM management (FR 68 40076 - 40101, July 3, 2003). The USFS and BLM are committed to habitat and land management actions that will serve to benefit lynx, and they have signed an agreement with the USFWS (referenced in FR 68 40076 - 40101, July 3, 2003) to operate in accordance with the Lynx Conservation Assessment and Strategy (Ruediger *et al.* 2000). Therefore, we find no reason to believe lynx recovery efforts in Colorado will be adversely affected by the many activities identified above that might occur in suitable lynx habitat areas. More importantly, WS-Colorado has no decision-making authority over these land management actions. Therefore, those actions and their effects are part of the existing human environment, whether or not WS-Colorado conducts any PDM activities.

WS-Colorado PDM actions do not alter or otherwise affect habitat. Such actions also have no potential to adversely affect the primary prey species of the lynx which is the snowshoe hare. No snowshoe hares have been taken as non-target animals by PDM activities in Colorado.

Currently, the only PDM methods used by WS-Colorado on USFS and BLM lands involve shooting (aerial or ground based), which are virtually 100% selective for target species. Thus, they pose no risk of taking a lynx in the areas where lynx are most likely to occur, which further lessens the chance of any contribution to adverse cumulative effects by WS-Colorado PDM. Any coyote removal from lynx habitat that occurs during PDM may actually benefit lynx (see additional discussion about T&E species that might benefit from WS-Colorado PDM later in this Chapter). Because WS-Colorado PDM activities have not contributed to any lynx mortality, and because the potential for those activities to contribute to future lynx non-target mortality is low, we find no reason to conclude that WS-Colorado PDM in the State is likely to contribute to any significant cumulative adverse effects on lynx.

River Otter: River otters, a state threatened species, were once widely distributed in Colorado, but were believed to be extirpated in the early 1900s. Otters prey on a variety of animals but prefer fish and crayfish. River otter have been successfully reintroduced into Colorado and have since been down-listed from endangered. The reintroduction sites, where more than 100 were released, included Cheesman Reservoir, and the Gunnison, Piedra, Dolores, and upper Colorado rivers. They now can be found in aquatic environments in much of Colorado (CPW 2016b).

Non-target take of river otters can be avoided by not trapping along lake shores, streams, and rivers where river otter sign is found. CPW has measures to reduce the potential for take. These are adhered to by WS-Colorado personnel and are listed in Chapter 2. WS-Colorado has not taken a river otter while conducting PDM during FY12-16, and it is unlikely we would take one under Alternative 1.

Gray Wolf: Gray wolves, a federal endangered species, were extirpated from in Colorado by the mid-1930s, but occasional migrants may enter Colorado from reintroduced populations in neighboring states. Several tools used in PDM such as foothold traps, snares, M-44s, and aerial PDM have the potential to take a wolf. Protective measures would be used by WS-Colorado to minimize risks to the gray wolf. These are discussed in Chapter 2, including several measures specific to gray wolves. No gray wolves have been taken by WS-Colorado since the 1930s. Gray wolf populations have been increasing and expanding in their experimental areas. WS-Colorado will be notified of verified wolf sightings by USFWS or CPW, and additional WS-Colorado will incorporate additional protective measures in these areas where wolves are known or expected to exist. In turn, WS-Colorado will notify USFWS and CPW if a WS-Colorado Specialist documents the presence of a gray wolf in Colorado. No extant population of gray wolves are known to exist in Colorado, and no predation by transient wolves has been reported in Colorado. However, transient wolves might cause damage in the future, and wolves might colonize Colorado in the future. WS-Colorado would conduct only passive non-lethal PDM measures to alleviate wolf predation to livestock. These might include fencing, fladry, pyrotechnics, lasers, effigies, moving livestock, range-riding, and strobe-sirens. No methods which might injure, harm, or kill a wolf would be used.

California Condor: California condors are federally listed as endangered. Some concern has arisen regarding the potential of PDM to affect condors that venture out of their experimental range in Arizona and enter Colorado. PDM tools that have the potential to affect California condors include the M-44, snares, foothold traps, and lead pellets/bullets ingested from carcasses of predators taken by shooting. Measures to reduce likely impacts to the condor are provided in Chapter 2. WS-Colorado has never taken a condor nor does WS-Colorado anticipate such an occurrence, and will abide by relevant measures to minimize any potential take anywhere condors come into Colorado. The experimental population of condors in Arizona has been increasing slowly through introductions and successful wild reproduction.

However, condors reproduce slowly and it may take some time to fully establish their population. Whereas California condors from the experimental population were documented to briefly visit Colorado in 1998, Colorado is outside the historic range of California condors, and they are not listed in Colorado.

Wolverine. Wolverines are listed by the State of Colorado as endangered. The largest member of the mustelid family (*e.g.*, weasels, skunks, badgers), the wolverine was probably never common in Colorado (Armstrong *et al.* 2011). Wolverines were found in higher elevation forests and alpine tundra. They most likely disappeared from Colorado in the early 1900s (CPW 2016c). Wolverines feed on carrion, and small birds and mammals. Some evidence suggests that they could still persist in Colorado. However, the last documented wolverine sighting was reported in 2012 near Rocky Mountain National Park. This wolverine's presence was first reported in 2009. Habitat protection and reintroduction could be considered to establish a viable population in the future. The historic range of wolverines and their habitat in Colorado mostly preclude them from being taken during PDM. Wolverines could be negatively affected by PDM, but they have been considered extirpated from the state. Therefore, Under Alternative 1, WS-Colorado PDM should have no effect on them.

Plains Sharp-tailed Grouse and Lesser Prairie-chicken: Plains sharp-tailed grouse is on Colorado's endangered species list. They are found in open habitat in the eastern portion of Colorado. Lesser prairie-chickens, a state threatened species, are found in short grass prairies of southeastern Colorado. Decline in these species has been linked primarily to habitat loss, although other factors may play a role (Arritt 1997). WS-Colorado would not use foot-hold traps, except those with pan-tension devices, where plains sharp-tailed grouse or lesser prairie-chicken are known to exist. For smaller predators of similar weight to these bird species, WS-Colorado would rely on cage traps or other methods in these areas. WS-Colorado has not added to any known take, and likely has benefitted many subpopulations of these species by conducting PDM in their range.

WS is currently conducting PDM nationally to protect several gallinaceous species, including the greater sage-grouse, from predators. In Colorado, lesser prairie-chicken and plains sharp-tailed grouse numbers have declined. Predators have been found to have at least some impact on grouse populations in their range, so PDM could have a positive effect on grouse populations by keeping their numbers at higher levels.

The Western Association of Fish and Wildlife Agencies Sage-grouse Management Guidelines (Connelly *et al.* 2000) suggest that PDM for protection of sage-grouse should be implemented only if nest success is less than 25%, or survival of adult hens is less than 45%, but they do not address the appropriateness of PDM in areas with low chick survival. Results of studies conducted in 1999 and 2000 in Idaho suggested that survival rates for sage-grouse chicks were only 15% and 18%, respectively, and that predators were responsible for 90-100% of the mortality (Burkepile *et al.* 2001). Although most sage-grouse management plans suggest indirect management of grouse-predator relationships through habitat manipulation, Schroeder and Baydack (2001) have suggested that managers should consider PDM as a management option and evaluate its viability through experimentation.

Gunnison Sage-grouse: The Gunnison sage-grouse was listed as federally threatened on November 20, 2014 (79 FR 69192). Gunnison sage-grouse occur on sage brush habitats and rangelands with a sage brush component in central Colorado in and near the Gunnison Basin. The species has declined in abundance due to substantial changes in habitat from human disturbance and small population size (Gunnison Sage-grouse Rangewide Steering Committee 2005). These population declines are exacerbated by the interaction of predation with habitat loss and small population size (Gunnison Sage-grouse Rangewide Steering Committee 2005). Changes in habitat affect the distribution of Gunnison sage-grouse on the landscape. Some habitat changes have resulted in increases in wildlife species that depredate Gunnison sage-grouse, resulting in negative population effects.

The decline of Gunnison sage-grouse is due to poor or no productivity (Davis *et al.* 2015), especially among the 7 small satellite populations (Davis *et al.* 2015, Oyler-McCance *et al.* 2005). Taylor *et al.* (2012) found female survival and chick survival were the most important vital rates for greater sage-grouse population growth, which is similar to little to no population growth afflicting Gunnison sage-grouse populations. The poor productivity and survival of chicks is likely attributed to declining habitat quality and introduction of anthropogenic habitat alterations harmful to sage-grouse survival. Many studies report habitat characteristics that have changed to the detriment of Gunnison and greater sage-grouse (Hovick *et al.* 2014, Aldridge *et al.* 2012, Hess and Beck 2012). Whereas habitat loss or change may be the proximate cause of sage-grouse decline, these changes introduce ultimate factors, such as predation, that cause population loss (Gregg and Crawford 2007).

Raven and corvid populations have increased significantly over the last 40 years as man has introduced anthropogenic structures into sagebrush habitat (Coates *et al.* 2016, Coates and Delehanty 2010, Manzer and Hannon 2005). Ravens depredate sage-grouse, and in some locations are impacting population growth and survivability of nests and eggs (Coates and Delehanty 2010,). These population losses normally would not occur in pristine sage brush habitat. WS Colorado has conducted limited raven damage management to protect Gunnison sage-grouse at one satellite population.

Most PDM projects have little potential to impact T&E species in Colorado because they are conducted in areas where T&E species, except Gunnison sage-grouse, are known to rarely be present. Many different methods and strategies are used to abate predation to livestock and wildlife species of management concern. However, two routine methods may disturb Gunnison sage-grouse. Aerial PDM and calling and shooting coyotes with or without decoy dogs may disturb Gunnison sage-grouse on leks during late winter and early spring. WS Colorado conducts aerial PDM on the Cerro Mesa, Sapinero Mesa (Gunnison Basin) and Crawford 0-2 times per year for 15-30 minutes per location to remove coyotes that may depredate sheep. Eleven aerial PDM flights were conducted over the 5 years with only 2 flights occurring after March 15. Gunnison sage-grouse were observed on leks during aerial operations over the years with about half the grouse staying on the lek and the other half dispersing into the sagebrush. Calling and shooting coyotes with or without the aid of decoy dogs has resulted in the dog or WS employee walking by or running by sage-grouse with grouse displaying various behaviors from observation, hiding and walking away from the dog or WS employee. These interactions are infrequent and do not happen in all years. In summary, the disturbances are infrequent and of short duration, resulting in no harm to the Gunnison sage-grouse. The removal of coyotes to protect sheep has collateral benefits to Gunnison sage-grouse by removing a potential predator, especially since the sage-grouse populations are low to very low on some sites where individual grouse are important to population recovery. PDM for the protection of Gunnison sage-grouse would have a beneficial impact and no adverse effects.

"Mesopredator release" has been identified as a potential indirect impact on sage-grouse due to coyote removal during PDM. Mesopredator release is the increase in smaller mammalian carnivore species after larger carnivores have been reduced or eliminated. Concerns have been expressed that red fox populations might increase in areas of sage-grouse habitat where coyote removal is conducted and that red fox would be worse predators of sage-grouse than coyotes (Gunnison Sage-grouse Rangewide Steering Committee 2005). The "mesopredator release" theory claims that smaller predators are allowed to increase due to either a lack of predation or release from competition or both. However, Gehrt and Clark (2003) present an opposing view of "mesopredator release" and point out several weaknesses in the circumstantial evidence that has been used to suggest that mesopredator release occurs. We believe it would be unlikely for WS-Colorado's coyote removal actions to lead to indirect increases in predation effects on sage-grouse populations. "Mesopredator release" is discussed in more detail under Issue C (Ecosystem Function; Section 3.3).

Burrowing Owl: The burrowing owl is a state threatened species which lives in abandoned rodent burrows, mainly those of prairie dogs and rabbits, in sparsely vegetated areas of Colorado. Of the PDM methods used by WS-Colorado, fumigants used for coyote and fox dens, could potentially affect burrowing owls. PDM in areas inhabited by burrowing owls could also potentially be a benefit to them, but no scientific studies have documented this. PDM methods used by WS-Colorado have never resulted in the take of a burrowing owl in Colorado, and it is unlikely that they would in the future under Alternative 1.

Piping Plover and Least Tern: The federally threatened piping plover and federally endangered least tern are found primarily from March through September in southeastern Colorado. The piping plover feeds primarily on invertebrates, and the least tern feeds on invertebrates and fish. Both species nest on sandy beaches, especially on islands. They are not negatively impacted by PDM, and can benefit from PDM where predation from species such as raccoons has been identified as a limiting factor for a particular colony. WS-Colorado has never taken a piping plover or least tern during PDM, and it is extremely unlikely that we would in the future under Alternative 1.

3.2.1.2 Effects on Bald and Golden Eagles.

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act and the MBTA. Some of the methods proposed for use in PDM have the potential to capture or kill eagles. There are also concerns about the risks to eagles from consumption of carcasses of animals taken by WS-Colorado that are killed with lead ammunition (Stauber *et al.* 2010, Bedrosian *et al.* 2012, Haig *et al.* 2014). Much of the risk of lead consumption in eagles appears to be associated with eagles foraging on waterfowl which have ingested lead ammunition, fishing tackle, or offal piles (Bedrosian *et al.* 2012, Haig *et al.* 2014). Stauber *et al.* (2010) detected an increase in eagles admitted to rehabilitation centers after the big game hunting season, and hypothesized that the increase might have been associated with an increase in coyote hunting, as hunters shifted from big game to coyotes at the end of hunting season. However, no increase in coyote hunting was documented. Multiple eagles and other scavengers can feed from single carcasses and are at risk from ingesting lead fragments. WS-Colorado disposes of carcasses of animals taken with lead ammunition in a manner that reduces risks to scavengers when possible. However, for some methods, such as removal via aircraft, burial or off-site disposal are generally not safe or practical options. The majority of coyotes taken by WS-Colorado are taken via use of shotguns from aircraft.

WS-Colorado uses copper-plated lead shot in all aerial PDM operations to minimize any likelihood of poisoning eagles or other scavengers. Hayes (1993) reviewed literature and determined the hazard of lead from shotgun pellets may have lower risks to eagles than some other types of ammunition. Some key findings were:

(1) Eagles are known to scavenge on coyote carcasses, particularly when other food sources are scarce or when food demands are increased.

(2) In studies that documented lead shot consumption by eagles (*i.e.*, based on examining the contents of regurgitated pellets), the shot was associated with waterfowl, upland game bird, or rabbit remains, and was smaller than BB or #4 buckshot used in aerial PDM.

(3) Lead residues have been documented in jackrabbits, voles (*Microtus spp.*), and ground squirrels, which could explain how eagles could ingest lead from sources other than lead shot.

(4) Frenzel and Anthony (1989) suggested that eagles usually reduce the amount of time that lead shot stays in their digestive systems by casting most of the shot along with other indigestible material. It appears that healthy eagles usually regurgitate lead shot in pellet castings which reduces the potential for lead to be absorbed into the blood stream (Pattee *et al.* 1981; Frenzel and Anthony 1989).

WS-Colorado personnel examined nine coyotes shot with copper plated BB shot to determine the numbers of shot retained by the carcasses. A total of 59 shot pellets were recovered, averaging 6.5 pellets per coyote. Of the 59 recovered pellets, 84% were amassed just under the surface of the hide opposite the side of the coyote that the shot entered, many exhibited minute cracks of the copper plating, and two shot pellets were split. The fired shot were weighed and compared with unfired shot and were found to have retained 96% of their original weight. Eagles generally peel back the hide from carcasses to consume muscle tissue. Because most shot retained by coyotes tends to end up just under the hide, it would most likely be discarded with the hide. Any shot consumed would most likely still have the nontoxic copper plating largely intact, reducing the exposure of the lead to the digestive system. These factors, combined with the usual behavior of regurgitation of ingested lead shot suggest a low potential for toxic absorption of lead from feeding on coyotes killed by aerial PDM. In fact, of known causes of anthropogenic mortality of golden eagles with satellite transmitters that were found dead, lead toxicity was the least common form of eagle mortality (USFWS 2016). Eagle mortality from WS-Colorado's use of lead ammunition is possible, although no known instances directly attributable to WS-Colorado actions have been reported.

Any potential effect from ingestion of lead ammunition appears to be limited to individual birds. Bald eagle populations are increasing in the contiguous 48 states. Golden eagle populations also appear to be healthy. Breeding Bird Survey Data indicate a general increasing trend in breeding populations of both golden and bald eagles in North America since 1966 (Sauer *et al.* 2004). Thus, eagle populations do not appear to be adversely affected by toxicity problems. Based on this information and the discussion below on lead impacts to non-target species, we conclude that WS-Colorado's use of lead ammunition could result in the death of some eagles, but that this impact is low relative to other sources of lead poisoning and is not having a significant cumulative adverse impact on eagle populations.

Under the Bald and Golden Eagle Protection Act, the definition of "*take*" includes actions that "*molest*" or *"disturb"* eagles. For the purposes of the Act, under 50 CFR 22.3, the term "*disturb*" as it relates to take has been defined as "*to agitate or bother a bald…eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."* Routine activities conducted by WS-Colorado's personnel under the proposed action alternative (Alternative 1) could occur in areas where Bald Eagles are present. However, WS-Colorado has reviewed those methods and the use patterns of those methods, and determined that they would not meet the definition of "disturb" requiring a permit for the non-purposeful take of Bald Eagles. The USFWS states, "*Eagles are unlikely to be disturbed by routine use of roads, homes, or other facilities where such use was present before eagle pair nesting in a given area. For instance, if eagles build a nest near your existing home, cabin, or place of business you do not need a permit*" (USFWS 2012). Therefore, activities that are species-specific and are not of a duration and intensity that would result in disturbance as defined by the Act would not result in non-purposeful take. Activities, such as walking to a site, discharging a firearm, or riding an ATV along a trail, generally represent short-term disturbances to sites where those activities take place. WS-Colorado would not conduct activities that were located near known eagle nests and would follow the National Bald Eagle Management Guidelines (USFWS 2007) to avoid disturbance. The categories that would encompass most of these activities are Category D (Off-road vehicle use), Category F (Non-motorized recreation and human entry), and Category H (Blasting and other loud, intermittent noises). These categories generally call for buffers of 330 feet for category D, 660 feet for category F, and ½-mile for category H (USFWS 2007).

One specific PDM method which could potentially adversely affect bald eagles is the use of foothold traps. To mitigate this impact, WS Directive 2.450 mandates that traps are placed at least 30 feet from carcasses or "draw stations." To date, WS-Colorado has not taken a non-target bald eagle, but acknowledges that the potential exists. Therefore, WS-Colorado will minimize these risks by abiding by the protective measures and measures to reduce the potential for take provided in Section 2.11. Bald eagle populations are increasing throughout their range indicating that mortality from all causes has not exceeded the sustainable threshold. WS-Colorado has not added to any known take of eagles during FY12-16.

Under Alternative 1, we do not anticipate any significant difference in our potential to impact eagles; thus, we expect no direct or indirect impacts to eagle populations from WS-Colorado PDM, and no cumulative impact.

3.2.1.3 Impacts on Non-target Animals from Consumption of Lead Fragments.

Agencies and members of the public have expressed concerns regarding the potential for adverse environmental impacts and risks to public safety from the materials used in ammunition. These would constitute indirect impacts from PDM by WS-Colorado. The majority of concerns expressed pertain to the use of lead ammunition, and this section correspondingly focuses on risks associated with lead (*e.g.*, Watson *et al.* 2009). However, it should be noted that some of the non-lead materials used in ammunition and lead-free ammunition (*e.g.*, arsenic, nickel, copper, zinc, tungsten) are also known to pose environmental risks (Clausen and Korte 2009a, 2009b, EPA 2005, Beyer *et al.* 2004, Eisler 1991, 1998a, 1998b). Exposure and risk to non-target animals would be greatest for wild and domestic animals that consume carcasses containing lead ammunition from PDM actions. There is also the potential for lead exposure to non-target mammals and birds from consumption of lead bullet fragments in the soil. The potential for lead exposure and risk to these types of scavengers would be reduced in situations where carcasses are removed or otherwise rendered inaccessible to scavengers through burial or state, territory, or tribally-approved carcass disposal practices. Lead exposure and risk would also be further reduced in cases where the use of lead-free shot can be effectively, safely, and humanely used to remove target animals.

For all programs, WS-Colorado uses lead-free ammunition when practical, effective, and available in order to mitigate and/or minimize the effects of its use of lead ammunition on the environment, wildlife, and public health and to comply with federal, state, territory, or tribal regulations on the use of lead ammunition. WS-Colorado does not use lead ammunition in areas where it is prohibited by law or where prohibited by the landowner/manager. WS-Colorado uses lead-free shot when using shotguns to remove birds for MBTA-permitted activities, including activities in waterfowl production and wintering areas.

The WS program has specific ammunition and firearm requirements to maximize performance, safety, and humaneness similar to those for other WDM applications (Caudell *et al.* 2012). Precision performance of bullets is essential for project efficacy, safety, humaneness (shot placement to result in rapid death) (MacPherson 2005, Caudell *et al.* 2009), and shot placement to preserve tissues for animal health monitoring. Direction of ricochet/ pass-through is difficult to predict (Burke and Rowe 1992) and is a safety concern, especially at airports, near residences, around rocky substrate, and for WS-Colorado personnel in aerial PDM teams. Ammunition which conveys its full energy to the target animal and which results in low or no pass through is needed for reasons of humaneness (instant or near-instant incapacitation) and to reduce safety risks associated with wounded animals.

Current challenges associated with lead-free ammunition include that some types of lead-free ammunition are harder than lead ammunition and more likely to ricochet off hard surfaces, which increases the odds of hitting aircraft, personnel, or other unintended targets, and presents unacceptable risks to human safety (APHIS 2012). WS has tested bismuth ammunition for aerial operations but found the product too frangible for safe and effective use. Increased wounding has been associated with lighter bullets (Aebischer *et al.* 2014). Lead-free alloys require longer bullets to obtain comparable bullet weights. Terminal performance (the performance of the bullet upon striking the target animal) is, in part, determined by bullet weight. Ballistically, a faster rate of twist is usually necessary to stabilize longer bullets, though individual firearm performance varies. Accuracy of non-lead ammunition is less than accuracy of lead ammunition in many of the firearms presently in use by WS-Colorado. Whereas non-lead ammunition is available in many calibers, its suitability and accuracy in all firearms is not universally equal to lead ammunition. Harder lead-free rifle ammunition is more likely to result in "non-frangible bullet pass-through," and failure of the bullet to convey its full energy to the target animal, although similar problems also exist with some types of lead rifle ammunition. In addition to the increased risk of hitting an unintended target, non-frangible pass through also increases the likelihood that the target animal may not be rapidly or instantly killed by the shot and may be considered less humane (APHIS 2012). WS-Colorado evaluates new lead-free ammunition alternatives as they become available.

Lead-free ammunition is often more expensive than equivalent lead ammunition. Costs may sometimes be secondary to overriding environmental, legal, public safety, animal welfare, or other concerns, but it is still an issue. Cooperators pay a substantial portion of operational program costs, and may be unwilling to pay the additional ammunition costs in areas where it is legal to use lead ammunition.

WS-Colorado aims to use the fewest number of shots on targeted animals. Lead ammunition use by WS-Colorado for PDM activities is minimal compared to lead use at firing ranges and use for hunting, fishing, and shooting sports. The national WS programs' FY08 - FY012 total estimated lead use in all program activities including feral swine damage management was approximately 5.87 tons (12,948 lbs.) with a yearly average of 1.174 tons (2,588 lbs.). The average yearly total amount of lead used in all states by WS (FY08-FY12) is small (0.0017%) compared to the U.S. use of lead from ammunition, shot, and bullets based on data from 2011 (Guberman 2013).

At the current rate of use, lead ammunition by WS-Colorado may have the potential to adversely impact individual non-target animals, particularly animals which scavenge carcasses, and birds which may inadvertently pick up lead shot when seeking grit for their crop. A review of population trends for the primary non-target avian scavengers of concern (turkey vultures and eagles) during 2003-2013, indicates that population trends for turkey vultures have been relatively stable in the state, and increasing in the Western BBS region and nationwide (USFWS 2016). Impacts of lead ammunition on eagle populations were discussed above. Based on this information, current use of lead ammunition is not adversely affecting overall populations of these species.

WS total program use of lead ammunition, including ammunition used for feral swine damage management is only a small fraction of lead ammunition use by other entities (*e.g.*, hunting, target shooting). WS adheres to all applicable laws governing the use of lead ammunition in WS activities and landowner/manager desires for lead-free ammunition in their projects. Additionally, the WS program is working to shift to lead-free ammunition as new lead-free alternatives that meet WS standards for safety, performance, and humaneness are developed and become reliably available in adequate quantities for program use. Use of lead ammunition by the APHIS program is anticipated to decrease over time. Consequently, cumulative impacts of WS-Colorado use of lead ammunition would be very low. Given that the majority of lead ammunition is used by non-WS-Colorado entities, the decisions made by states, territories, tribes, federal regulatory agencies, and land management agencies regarding use of lead ammunition will be the greatest factor affecting the cumulative contribution of lead in the environment. If state or federal law or WS-Colorado policy were changed to require an adherence to more restrictive use of lead ammunition, WS-Colorado would adopt the more stringent measures into its protective measures accordingly.

3.2.1.4 Impacts on wildlife populations caused by low-level flights during aerial PDM.

Concern is sometimes expressed that aerial PDM might disturb other wildlife species populations to the point that their survival and reproduction are adversely affected, and thus lead or contribute in some significant way to population declines. A number of studies have looked at responses of various wildlife species to aircraft overflights. The National Park Service (1995) reviewed many such studies and revealed that a number of them have documented responses by certain wildlife species that suggest adverse impacts could occur. Few, if any studies have documented significant adverse impacts on wildlife populations caused by aircraft overflights, although the report stated it is possible that impacts are occurring. The Air National Guard (ANG) came to the conclusion that military training flights were not expected to cause adverse effects on wildlife after extensive review of numerous studies of this issue (ANG 1997).

WS-Colorado aerial PDM activities are infrequent, of short duration, and cover only a small proportion of geographic area involved. During FY12-16, WS-Colorado conducted aerial PDM on agreements which comprised 2,331 mi^2, which is 2.2% of the 104,185 mi^2 in the State of Colorado. WS-Colorado PDM, including aerial PDM, is typically only conducted on a small proportion of any property under agreement. WS in New Mexico (WS 1997) compared the specific pasture areas on which PDM lethal methods were expected to be used to the total area under WS agreements in the Albuquerque WS District. That analysis indicated the actual area subjected to WS PDM was less than 1/5 of the total area under agreement (WS 1997). For example, an entire property under a WS agreement may contain 3,200 acres, but the WS Specialist may determine that there is only a need to work in a particular area that covers 640 acres, because that is where the damage is occurring, or because that is where the offending predators can be targeted. We believe that the scenario is similar in Colorado; WS-Colorado actually conducts PDM, including aerial PDM, on approximately 1/5 of lands under agreement. Using this calculation, less than 0.5% of the land area of Colorado was exposed to WS-Colorado aerial PDM in a typical year. WS aerial PDM only occurs on a small fraction of the land area in the state, and therefore only has limited potential to impact non-target species.

WS-Colorado also does not work continuously throughout the year on these properties, and generally spends only a few hours or days on any specific property during the year resolving predator damage problems. During FY12-16, WS-Colorado flew an average of 580 hours per year for aerial PDM, which includes all properties flown.

WS-Colorado does not anticipate that the percentage of lands under agreement or the number of hours flown would increase substantially over the next five to ten years. Under Alternative 1, WS-Colorado would spend less than 700 hours conducting aerial PDM, covering <1% of the lands in Colorado in any typical year, based on the analyses above.

Waterbirds and Waterfowl: Low level overflights of 2-3 minutes in duration by a fixed-wing airplane and a helicopter produced no "drastic" disturbance of tree-nesting colonial waterbirds, and, in 90% of the observations, the individual birds either showed no reaction or merely looked up (Kushlan 1979). Conomy *et al.* (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level flying military aircraft in North Carolina and found that only a small percentage (2%) of the birds reacted to the disturbance. They concluded that such disturbance was not adversely affecting the "time-activity budgets" of the species. Other reviews have suggested there may be adverse effects on waterfowl (National Park Service 1995). WS aerial PDM activities are not conducted over wetland habitats, and a majority of such flights occur in winter when waterfowl and other waterbirds have migrated further south. Thus, there is little to no potential for any adverse effects on these types of species.

Raptors: Mexican spotted owls (*Strix occidentalis lucida*) did not flush when chain saws and helicopters were greater than 110 yards away; owls flushed to these disturbances at closer distances and were more prone to flush from chain saws than helicopters. Owls returned to their pre-disturbance behavior 10-15 minutes following the event, and researchers observed no differences in nest or nesting success, which indicates that helicopter flights did not result in adverse effects on owl reproduction or survival (Delaney *et al.* 1999).

Andersen *et al.* (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded that red-tailed hawks habituate to low level flights during the nesting period. Their results showed similar nesting success between hawks subjected to such overflights and those that were not. White and Thurow (1985) found that ferruginous hawks (*B. regalis*) are sensitive to certain types of ground-based human disturbance to the point that reproductive success may be adversely affected. However, military jets that flew low over the study area during training exercises did not appear to bother the hawks, nor did the hawks become alarmed when the researchers flew within 100 feet in a small fixed-wing aircraft. White and Sherrod (1973) suggested that disturbance of raptors by aerial surveys with helicopters may be less than that caused by approaching nests on foot. Ellis (1981) reported that five species of hawks, two falcons (*Falco spp.*), and golden eagles were "incredibly tolerant" of overflights by military fighter jets, and observed that, although birds frequently exhibited alarm, negative responses were brief and the overflights never limited productivity.

Regarding potential effects of WS aircraft overflights on bald eagles, ANG (1997) analyzed and summarized the effects of overflight studies conducted by numerous Federal and state government agencies and private organizations. These studies determined that military aircraft noise initially startled raptors, but negative responses were brief and did not have an observed effect on productivity (Ellis 1981, Fraser *et al.* 1985, USFS 1992). A study conducted on the impacts of overflights to bald eagles suggested that the eagles were not sensitive to this type of disturbance (Fraser *et al.* 1985). During the study, observations were made of over 850 overflights of active eagle nests. Only two eagles rose out of either their incubation or brooding postures. This study also showed that perched adults were flushed only 10 percent of the time during aircraft overflights. Evidence also suggests that golden eagles are not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen *et al.* 1990). Finally, one other study found that eagles were particularly resistant to being flushed from their nests (Awbrey and Bowles 1990, cited in ANG 1997). There is considerable evidence that eagles would not be adversely affected by WS-Colorado aerial PDM overflights.

The above studies indicate raptors are relatively unaffected by aircraft overflights, including those by military aircraft which produce much higher noise levels than the small aircraft used in aerial PDM. Therefore, we conclude that WS-Colorado aerial PDM flights have little or no potential to adversely affect raptors.

<u>Passerines</u>: Reproductive losses have been reported in one study of small territorial passerines (songbirds such as sparrows and blackbirds) after exposure to low altitude overflights (Manci *et al.* 1988), but natural mortality rates of both adults and young are high and variable for most passerines. The research reviewed indicated that passerine birds cannot be driven any great distance from a favored food source by a non-specific disturbance, such as military aircraft noise, which suggests that the much quieter noise of WS small planes would have even less effect. Passerines avoid intermittent or unpredictable sources of disturbance more than predictable ones, but return rapidly to feed or roost once the disturbance ceases (Gladwin *et al.* 1988, USFS 1992). These studies and reviews indicate there is little or no potential for WS-Colorado overflights to cause adverse effects on passerine bird species.

<u>Sage-grouse</u>: We could find no studies of the effects of overflights on sage-grouse. However, impacts are probably minor when overflights only occur on an infrequent basis and care is taken to avoid leks (strutting grounds used by males during the breeding season), because state wildlife agencies routinely use aircraft to locate sage-grouse leks. The USFWS reviewed available scientific and other information on threats to sage-grouse and did not identify aerial overflights as a concern, although they did identify other types of activities such as off-road vehicles and recreation as potentially having disturbance effects on breeding (USFWS 2010). Because WS-Colorado avoids flying near known or observed lek locations during the strutting season, any potential disturbance effects on breeding are most likely avoided. One potential benefit to sage-grouse is that WS-Colorado aerial crews can watch for and report any new lek locations to the CPW or land management agencies who can then take other actions to protect such sites from other, more potentially more chronic sources of disturbance, when appropriate. The Gunnison Sage-grouse, which is a federally threatened species, is most abundant in sagebrush habitats in Gunnison County, but they also inhabit suitable sagebrush habitats in Dolores, San Miguel, Montrose, and Saguache counties in southwestern Colorado. WS-Colorado aerial PDM activities have occurred in 3 of those counties (Gunnison, Montrose, and San Miguel) in the past 5 years. Because WS-Colorado aerial PDM crews watch for and avoid leks during the breeding season, no adverse effects on Gunnison sage-grouse are expected. PDM activities that remove coyotes and red fox (the species usually targeted by WS-Colorado aerial PDM activities) may actually benefit sage-grouse and other prairie grouse species by reducing predation by these species.

<u>Deer</u>: Krausman *et al.* (1986) reported that fixed-wing overflights by Cessna 172 and 182 model small aircraft $\geq$ 100 feet above ground level (AGL) did not generally disturb desert mule deer in Arizona. They observed that only 3 of 70 observed responses of mule deer to the overflights at 150 to 500 feet AGL resulted in the deer changing habitats. The few that did change habitats did so on the first overflight experience, but then did not change habitats on subsequent overflight exposure. The aircraft they evaluated are larger and noisier than the J3 Supercub and Husky airplanes used for most WS-Colorado aerial PDM. VerCauteren and Hygnstrom (2000) noted in a study that included aerial censuses of deer that deer typically just stood up from their beds, but did not flush, when the aircraft passed overhead. In addition, WS-Colorado aerial PDM personnel frequently observe deer and antelope standing apparently undisturbed beneath or just off to one side of WS aircraft.

One particular concern with overflights is the potential to affect mule deer on their winter range in years when conditions such as heavy snow and poor forage availability have already stressed the deer to the point that heavy "winter kill" losses are likely. WS-Colorado has conducted aerial PDM to protect sheep in several areas of known deer winter range, particularly in the Little Snake and White River BLM RAs. However, the potential for adverse effects on wintering deer, particularly during severe winter conditions, is minimized by the fact that WS-Colorado's aerial PDM pilots are instructed to avoid concentrations of deer and other readily visible non-target wildlife (L. Burraston, National Aviation Manager, WS, pers. comm. 2005).

Also, removal of coyotes during winter may benefit wintering mule deer herds to some extent. Coyotes are documented to cause substantial direct mortality of wintering deer. For example, Mackie *et al.* (1976) documented high winter losses of mule deer due to coyote predation in north-central Montana and stated that coyotes were the cause of most overwinter deer mortalities. Hurley *et al.* (2011) also found coyote removal increased fawn survival under certain conditions. Coyotes may cause additional stress on wintering deer indirectly from the stress of chasing and pursuit. This source of stress is most likely reduced by the removal of coyotes through aerial PDM and other PDM activities during or prior to severe winter periods. Gese and Grothe (1995) found that territorial alpha coyotes (*i.e.*, dominant breeding males and females) were more likely than subordinate coyotes to prey on, or at least pursue in an attempt to prey upon, wintering mule deer and elk. During winter, coyote populations are at or approaching their lowest numbers in their annual cycle (Knowlton *et al.* 1999). They also have the highest proportion of older adults during winter, which are more likely to pursue and attack wintering deer and elk than younger, less experienced coyotes (Gese and Grothe 1995; E. Gese, pers. comm. 2005). Removal of adult coyotes on winter range at that time of year would therefore be expected to result in at least some reduction in direct winter predation and indirect impacts (*e.g.*, pursuit) on deer. Thus, it is likely that the relatively infrequent and brief aerial PDM activities that occur on deer winter range actually result in at least some level of net benefit to the deer populations allowing more deer to survive through severe winter periods.

Mule deer populations on a statewide basis have fluctuated over the years, and are currently estimated to be about 400,000. The population reached a high of about 625,000 in the early 1980s, fluctuated between 500,000 and 600,000 from the early 1980s to early 2000s, and has recently dropped back to pre-1980s numbers (Figure 3-3). Whereas deer numbers have declined since 2006, we find no evidence that this is due in any part to aerial PDM. In fact, a previous EA (WS 2005) showed consistently high and increasing deer numbers from 2000-2004, when aerial PDM was also occurring. No significant changes to our aerial PDM program have occurred since then, so the recent declines in deer populations must be due to some other factor(s).

In April 2013, CPW held an internal summit regarding the declining mule deer population in western Colorado, and they identified ten management concerns: barriers to migration, competition with elk, disease, doe harvest and hunting demands, declining habitat quality, habitat loss, highway mortality, predation, recreational impacts, and weather (CPW 2014a). Recent research suggests that the most significant factors affecting mule deer populations in the western U.S. are weather and habitat, and to a lesser extent, predation. This includes the quantity and quality of winter forage, winter severity, summer precipitation, and to some extent, mountain lion predation (Bishop *et al.* 2008, Hurley *et al.* 2011). To our knowledge, research has never cited occasional overflights on winter range as a limiting factor for deer survival. In fact, researchers commonly use aerial surveys to determine survival rates and population trends.

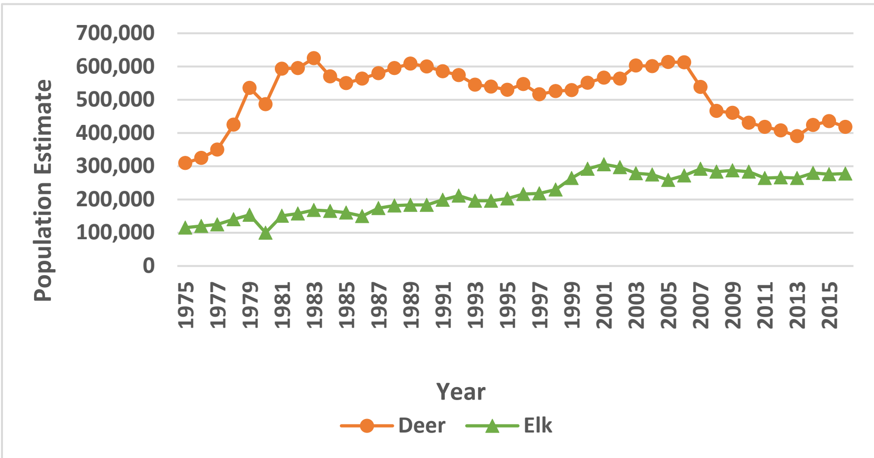


Figure 3-3. Colorado deer and elk population trends from 1975 to 2016 (CPW 2017a and A. Holland, Big Game Coordinator, CPW, *unpubl. data* 2015).

Accordingly, CPW expressed the opinion that aerial overflights on deer winter range during severe winter periods should not adversely impact deer if flights over deer are of short duration (B. Watkins, Big Game Coordinator, CPW, pers. comm. 2005). WS-Colorado's aerial PDM overflights in these areas (*e.g.*, BLM and USFS grazing allotments) are of short duration and low frequency (discussed further below). We found no evidence that WS-Colorado aerial PDM overflights on deer winter range cause any substantive adverse impacts on deer populations.

We conclude that WS-Colorado aerial PDM operations produce minimal disturbance to deer, which will have no impact on their populations. In fact, it is probable that aerial PDM results in some level of net benefit to such populations due to decreased predation.

Elk: We could find no studies on the impacts of aerial overflights on elk. However, Espmark and Langvatn (1985) found that the species does become habituated to noise. Further, elk populations on a statewide basis have remained stable at near-record-high levels over the last ten years, while WS-Colorado aerial activities have been occurring (Figure 3-3). The Statewide population has increased from about 115,000 in 1975 to more than 260,000 today. No significant cumulative impact on elk populations from aircraft overflights, or any other stressor, is apparent.

Bighorn sheep: Krausman and Hervert (1983) reported that, in 32 observations of the response of bighorn sheep to low-level flights by small fixed-wing aircraft, 60% resulted in no disturbance, 21% in "slight" disturbance, and 19% in "great" disturbance. Another study found that 14% of bighorn sheep had elevated heart rates that lasted up to 2 minutes after an F-16 flew over at an elevation of 400 feet, but it did not alter the behavior of the penned bighorns (Krausman *et al.* 1998). Weisenberger *et al.* (1996) found that desert bighorn sheep and mule deer had elevated heart rates for 1 to 3 minutes and changed to alert behavior for up to 6 minutes following exposure to jet aircraft. Thus, bighorns' response to overflights appears to be limited and transient, even from much louder aircraft than used by WS.

Areas of bighorn sheep habitat are also generally too rugged to be suitable for aerial PDM. And as stated previously, WS pilots are instructed during training to avoid non-target wildlife, including bighorn sheep. Therefore, we find little or no potential for WS aerial overflights to cause any effects on bighorn sheep.

Bison: Fancy (1982) reported that only 2 of 59 bison (*Bison bison*) groups showed any visible reaction to small fixed-wing aircraft flying at 200-500 feet AGL. Therefore, available evidence indicates bison herds would not be adversely affected by aerial PDM overflights that happen to occur in areas they inhabit. Moreover, bison overflights are expected to be an extremely rare event, because WS-Colorado rarely conducts aerial PDM in areas of wild bison herds in Colorado, and WS pilots are instructed to avoid non-target wildlife.

Pronghorn (antelope): Krausman *et al.* (2004) found that Sonoran pronghorn (a T&E species in Arizona) were not adversely affected by military fighter jet training flights and other military activity on an area of frequent and intensive military flight training operations. They also reported that pronghorn and desert mule deer do not hear noise from military aircraft as well as humans do, which would explain why they appear not to be disturbed as much as previously thought. Therefore, available scientific evidence indicates that overflights do not cause any adverse effects on pronghorn populations. The statewide pronghorn population has been on an increasing trend since the late 1970s. During FY00-04, the analysis period for a prior EA (WS 2005), pronghorn numbers steadily increased, and during FY10-14, pronghorn numbers reached a record high (Figure 3-4). WS-Colorado conducted aerial PDM throughout these timeframes. Thus, there does not appear to be any deleterious effect of occasional overflights on pronghorn populations. We are unaware of any studies that indicate that coyotes can cause significant winter mortality of pronghorns, but removal of coyotes in winter might theoretically reduce fawn predation in the spring, much like it reduces lamb losses in the spring (Wagner and Conover 1999). If so, then aerial PDM of coyotes may have a net benefit to pronghorn populations.

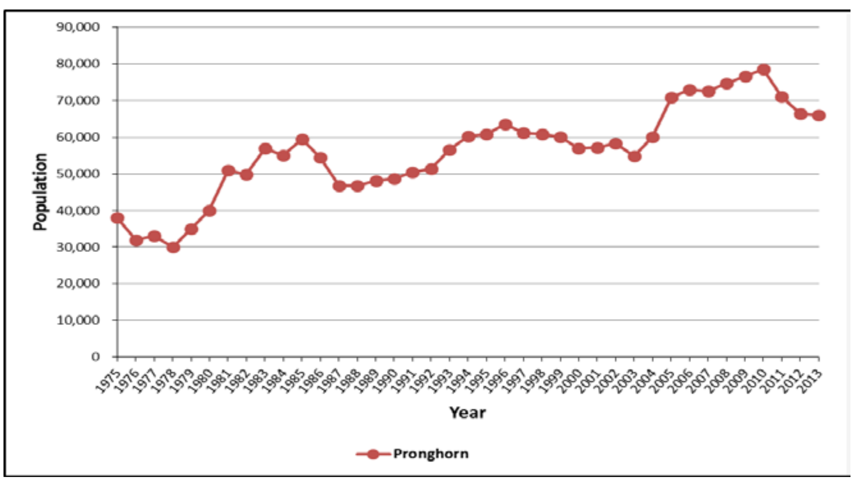


Figure 3-4. Colorado pronghorn population trend from 1975 to 2013 (A. Holland, Big Game Coordinator, CPW, *unpubl. data* 2015).

Wild Horses: Four wild horse areas are located on BLM lands in Colorado (Piceance Basin, Little Bookcliffs, Sandwash Basin, and Spring Creek). Concern is sometimes expressed that aircraft overflights could impact horses. We could not find studies conducted specifically on wild horse response to aircraft overflights. Wild horses have been reported to become alarmed at the sight and sound of helicopter activity, especially in areas where helicopters are predominately used by BLM during round-ups. However, the small fixed-wing aircraft that are used by WS are much quieter than helicopters, and Wild horses in the proximity of WS aerial PDM operations in Nevada have completely ignored the fixed-wing aircraft, even to the point of not getting up from a recumbent position (WS 1999). We conclude that WS-Colorado's aerial PDM activities would likely have no significant effect on wild horses.

Domestic Animals and Small Mammals: A number of studies with laboratory animals (*e.g.*, rodents [Borg 1979]) and domestic animals (*e.g.*, sheep [Ames and Arehart 1972]) have shown that these animals can become habituated to noise. Long term lab studies of small mammals exposed intermittently to high levels of noise demonstrate no changes in longevity. The physiological "fight or flight" response, while marked, does not appear to have any long-term health consequences on small mammals (ANG 1997). Small mammals habituate, albeit with difficulty, to sound levels greater than 100 dBA (A-weighted decibels) (USFS 1992). As shown below, the noise levels of the aircraft used by WS are low in comparison to other aircraft. Small mammals such as field rodents and rabbits have small home ranges and are generally widely distributed. WS only conducts aerial PDM on less than 0.5% of the land area of the State during an average year [1/5 of the 2.2% of acres in agreements which were flown, using the calculus of WS (1997)], which indicates that more than 99% of small mammal populations are not exposed to WS-Colorado aerial PDM overflights. And such flights occur only a few days per year, which further decreases the potential for any significant adverse impacts. Regarding potential effects on livestock, the only persons likely to have concerns are livestock owners or managers. However, they are the ones requesting PDM assistance in most cases, and they are more concerned with stopping or preventing predation on their livestock. Livestock managers do express concern for such disturbances, but WS policy requires pilots to stays at least 500 feet from livestock during aerial PDM. This precludes livestock disturbance in most cases, based on personal observations of WS aerial crews.

3.2.1.5 Impacts from noise due to WS-Colorado aircraft used in aerial PDM.

WS uses small fixed-wing aircraft and, on occasion, small helicopters for aerial PDM. Helicopters have been used very infrequently in recent years due to the higher costs of operation than fixed-wing aircraft. During FY12-16, WS-Colorado did not use helicopters for aerial PDM, but they have been used in the past, and might be used in the future under Alternative 1. The fixed-wing aircraft used by WS are relatively quiet, whereas helicopters are somewhat noisier. As stated previously herein, the noise level of the J3 Supercub (Piper PA-18), which is not as quiet in operation as the Husky airplane model also used by WS (L. Burraston, WS National Aviation Manager, pers. comm. 2005), is reported by FAA to be 65 dBA when measured directly underneath the airplane flying at 500 feet AGL. Put in perspective, that noise level is similar to "normal conversation at 5 feet" (in a commercial area). In comparison, most military jet aircraft noise levels at 500 feet AGL range from 97 to 125 dB at various power settings and speeds (Keeney 1999). To experience the same level of noise by common military aircraft as one would experience directly beneath a J3 Supercub in flight, one would have to be nearly 2 miles away from an F-16 and more than 3.7 miles away from a B-1B flying at 200 to 1000 feet AGL (from data presented in ANG 1997). The effects on wildlife from these and other similar types of military aircraft have been studied extensively as shown in the information presented in this section, in ANG (1997), and references therein, and were found to have no expected adverse effects on wildlife. The aircraft used in aerial PDM have far less potential to cause any adverse effects on wildlife than these military aircraft because the military aircraft produce much louder noise and are flown over certain training areas as many as 2,500 times per year. Further lessening the potential for effect from WS aerial PDM flights is that they occur on a small percentage of the land area of the State and of public lands. See below for a more complete analysis of WS-Colorado aerial PDM on public lands.

3.2.1.6 Summary of aircraft overflight impacts to wildlife.

The above analysis indicates that most bird and mammal species are relatively tolerant of aircraft overflights, even those that involve noise at high decibels such as from military aircraft. It appears that some species will frequently, or at least occasionally, show what appear to be adverse responses to even minor overflight occurrences. In general, the greatest potential for impacts would be expected when overflights are frequent and over many days, which could represent "chronic" exposure. Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. Even then, many wildlife species become habituated to frequent overflights, which appears to naturally mitigate for adverse effects on their populations in local areas where such flights occur on a regular basis. WS aerial PDM operations occur in relatively remote rangeland areas and not near commercial airports or military flight training facilities. In addition, WS conducts very few flights over any one area in any one year as shown by the data in Tables 3-15b, 3-17, and 3-19. WS-Colorado aerial overflights have little potential to result in "chronic" exposure in any local area, and would have negligible or no impact on non-target wildlife populations.

3.2.1.7 Effects of gunshot noise on wildlife.

Some commenters have expressed concern that gunshot noise during WS-Colorado aerial PDM activities might result in significant disturbance impacts on wildlife species. A few studies have indicated that gunshot noise can alter behavior of some wildlife species, including waterfowl (Meltofte 1982) and eagles (Stalmaster and Newman 1978). It has also been suggested that firearms noise affects species that are hunted due to their association of such noise with being pursued and shot at by humans (Larkin *et al.* 1996). However, the time spent shooting at coyotes from aircraft during aerial PDM flights is an exceedingly small proportion of flight times. WS-Colorado aerial PDM data for FY12-16 show an average of 2.1 predators killed per hour of aerial PDM. A typical "pass" in which shots are taken at a predator takes usually involves 2 to 4 shots with a 12 gauge shotgun in rapid succession. Time spent shooting during each pass is generally 2 to 3 seconds or less. It generally takes an average of just more than 1 pass to successfully shoot and kill a predator (because most are killed on the first pass). Using high estimates of 3 seconds of shooting per pass and 2 passes per predator, we estimate that at most, less than 15 seconds of each hour of flying time (less than 0.5% of the time spent aerial PDM) is actually spent shooting at target animals and generating gunshot noises. WS flew an average of 580 hours per year in FY12-16, which corresponds to less than 3 hours per year generating gunshot noises statewide. WS took an average of 1,209 predators per year during aerial PDM activities in FY12-16 in Colorado. At an estimated average of 4 shots per predator killed, the number of shots fired by WS per year during aerial PDM is less than 5,000 statewide.

As part of the existing human environment, about 259,000 persons participated in hunting in Colorado in 2013, who spent 2.2 million person-days hunting, and killed about 86,000 big game animals and more than 880,000 small game animals (CPW 2014b, 2014c, 2014d, Raftovich *et al.* 2014). The number of shots fired by private hunters each year would, at a highly conservative estimate of 2 shots fired per animal killed, would be more than 1.9 million. WS's contribution to overall gunshot noise in areas of wildlife habitat is less than 0.3% of the number of shots fired at wild animals in the state each year. Therefore, WS adds only exceedingly small amounts of gunshot noise to that which occurs annually as part of the existing human environment in wildlife habitat areas of Colorado.

Also, shooting from aircraft is virtually always at an extreme downward angle towards the ground. Pater (1981 *cited in* Larkin 1996) reported that muzzle blast is louder in the direction toward which the weapon is pointed by up to 14 decibels. Thus shooting downward toward the ground would serve to lessen the noise in lateral directions from the aircraft. WS personnel on the ground observing aerial PDM training passes in which shots are taken report that the gunshot noise heard at a distance of 150 yards or more is more like a "pop" noise rather than the sound of an explosion (L. Burraston, National Aviation Manager, WS, pers. comm. 2005). This suggests that shotgun noise from WS aerial operations is not loud enough to cause disturbance to wildlife at a distance. And because WS Policy requires pilots to avoid non-target wildlife, they are generally not close enough to be disturbed. Animals that happen to be directly beneath or in close proximity to the aircraft when shooting passes are made will undoubtedly hear the firearm noise as much louder, but the only wildlife generally within this proximity are the target predators.

All of these factors suggest that the gunshot noise from WS aerial PDM does not negatively impact wildlife in Colorado.

3.2.1.8 Cumulative impacts of aircraft overflight.

Some public comments to prior versions of this EA have raised the concern that WS-Colorado aerial PDM overflights, when added to other types of low level overflights, might result in cumulative adverse effects on certain wildlife species populations.

Besides PDM, WS-Colorado also conducted aerial activities for feral swine damage management during FY12-16. These activities were very limited in duration, frequency, and geographic scope, even when compared to the WS-Colorado aerial PDM activities discussed above. During FY12-16, WS-Colorado flew an average of 3.2 hours per year for feral swine. This includes 2 flights per year on average. Aerial feral swine management in Colorado represents less than 1% of additional flight hours over the PDM aerial PDM analyzed above. This small increase does not alter our analyses or determinations in those Sections. Moreover, most (80%) of the aerial feral swine management was conducted in Baca County, where very little aerial PDM was conducted (0.1% of total flight hours). The number, length, and acreage of these flights will likely increase for a few years, due to increased efforts for feral swine damage management. We anticipate that WS-Colorado might fly up to 200 hours per year for feral swine.

The only other aerial PDM that occurs in Colorado besides that performed by WS-Colorado is by private individuals under a permit from either CDA (for livestock protection) or CPW (if they approve it for wildlife protection). No permits for wildlife protection by private entities have been issued by CPW in a number of years. CDA-permitted aerial PDM by entities other than WS has been limited in terms of magnitude, frequency, and geographic scope. On average, 45 predators were killed per year by private aerial PDM during FY12-16, all of which were coyotes. The number of hours flown was only available for FY14-16. The average number of hours flown during this timeframe was 39 hours per year. We will use this to approximate the average annual hours flown during the analysis period of this EA, FY12-16. The counties flown by private entities included Moffat, Rio Blanco, and Bent. In Moffat County, private entities took an annual average of 19 coyotes over 18 hours of aerial PDM. In Rio Blanco County, private entities took an annual average of 7 coyotes over 6 hours of aerial PDM. For Bent County, private entities took an annual average of 28 coyotes over 23 hours of aerial PDM.

Thus, cumulative aerial PDM in Colorado averaged 619 hours per year, 94% of which was conducted by WS, and 6% of which was conducted by private individuals. This represents an increase of approximately 7% over the WS aerial PDM activities analyzed above. This small increase does not alter our analyses or determinations in those Sections.

Also, none of the permits authorized aerial PDM on federal public lands (W. East, CDA, email 2015). Therefore, private aerial PDM has had no potential to contribute to cumulative impacts from overflight effects to wildlife on public lands. It is expected that private aerial PDM will not increase above levels that occurred over the last several years unless WS reduces its aerial PDM activities. We find no reason to expect potential impacts on non-target wildlife species from private aerial PDM to increase over the levels that have occurred recently. Private aerial PDM is expected to contribute minimally to cumulative overflights, and would thus not result in any significant cumulative impacts.

The Air National Guard finalized an EIS (ANG 1997) on a proposal to expand military training flights in Colorado. That EIS contains considerable analysis on the potential for military training overflights by jet aircraft to adversely affect numerous wildlife species, and we refer readers to that document for a more thorough coverage of the detailed analysis. Below, we identify those areas and counties within Colorado where military training flights occur. In summary, the analysis in that EIS established the following:

- Many studies exist that have documented behavioral responses in wildlife, but those studies have not provided evidence that wildlife species populations have been adversely affected to any substantial degree. ANG (1997) concluded that their Preferred Alternative (the "Colorado Airspace Initiative"), which involved from 62 to 2,461 "sorties" (military training flights) on 14 separately identified airspace components per year, was not expected to result in any significant environmental impacts. In particular, ANG concluded that no adverse impacts were expected on any wildlife species in any of the airspace components where the training flights would occur.
- Aircraft overflights within 650 to 1,640 feet have been shown to increase the heart rates and cortisol levels of large herbivores (USFS 1992). However, even when animals flee temporarily from approaching aircraft, available evidence suggests risks of damage are low, as animals flee with caution and do not injure themselves when startled or frightened.
- Studies of wildlife subjected to aircraft overflights have not shown evidence of compromised reproduction, either directly or indirectly (USFS 1992).
- A majority of the literature reviewed led to the conclusion that numerous wildlife species have the ability to adapt to the presence of man and various man-made sound sources, including jet aircraft noise. Although initially startling, habituation to jet aircraft noise occurs with most wildlife species.
- No published scientific evidence was identified that indicated harm may occur to wildlife as a result of exposure to the levels of noise generated by military aircraft that would utilize the airspace associated with military training flight areas.
- USFWS and state wildlife agencies expressed some concerns about the potential for adverse effects from military overflights on waterfowl in waterfowl habitat areas, and on bighorn sheep in their lambing areas. WS-Colorado does not conduct aerial PDM actions in those types of areas unless requested by responsible wildlife management agencies; conversely, in other states, WS has been requested to protect waterfowl nesting areas from coyote predation impacts, and aerial PDM has been used to meet those objectives to enhance waterfowl populations.
- It can be concluded that the activities associated with the Colorado Airspace Initiative (the preferred alternative in ANG (1997)) will not adversely affect wildlife species within the

region of influence.

The ANG (1997) EIS analysis thus shows that military overflights, even where they occur on a regular basis up to many hundreds of times a year over specific areas, are not likely to result in adverse effects on wildlife. ANG (1997) described the locations of areas in and routes on which military training flights occur in Colorado. The areas, Military Operations Areas (MOAs), and training flight routes are shown in Figure 3-5

Table 3-15b. Average number of WS-Colorado aerial PDM flights and military training flights (sorties) during federal Fiscal Year 2012-16 in Colorado counties where military training flights occur (ANG 1997). .

County	Average WS Flights per Year	Number of Military Sorties per Year		WS Flights as Percentage of Total Flights
		MOA or Training Route	Sorties	
Las Animas		Pinon Canyon MOA	62	
		Two Buttes Low MOA	475	
		Two Buttes High MOA	845	
		IR-409 Whole Route	53	
		IR-409 Segments F to I	845	
		XVR-1427 Whole Route	343	
		XVR-1427 Segments F to I	185	
Las Animas Total	**0.2**	**7 MOAs/Routes**	**2,808**	**0.01%**
Otero		Pinon Canyon MOA	62	
		Two Buttes Low MOA	475	
		Two Buttes High MOA	845	
Otero Total	**2.8**	**3 MOAs/Routes**	**1,382**	**0.2%**
Crowley		IR-415 Segments A to D	88	
		IR-414	62	
		XIR-424	211	
Crowley Total	**3.4**	**3 MOAs/Routes**	**361**	**0.9%**
Baca		Two Buttes Low MOA	475	
		Two Buttes High MOA	845	
		IR-409 Whole Route	53	
		IR-409 Segments F to I	845	
Baca Total	**0.8**	**4 MOAs/Routes**	**2,218**	**0.04 %**
Lincoln		IR-415 Segments A to D	88	
Lincoln Total	**3.0**	**1 MOA/Route**	**88**	**3.4 %**
Fremont				
Fremont Total	**0**			
Weld		IR-416	62	
		XIR-426	62	
Weld Total	**0.2**	**2 MOAs/Routes**	**124**	**0.2%**
TOTAL	**10.4**	**20 MOAs/Routes**	**6,981**	**0.1%**

WS-Colorado conducted aerial PDM in 6 counties (Baca, Crowley, Las Animas, Lincoln, Otero, and Weld) during FY12-16 where military training flights (called "sorties") also occurred (Table 3-15b). When the number of WS-Colorado flights is added to military sorties, WS-Colorado's flights comprise only 0.1% of the total flights in those Counties. Therefore, WS-Colorado flights do not add significantly to the total number of overflights in any of the affected counties. Moreover, aircraft used by WS-Colorado are considerably quieter than those used by the military. In conclusion, cumulative effects of WS-Colorado and military overflights are not likely to produce any significant impacts on wildlife.

At least one comment received from the public in a prior version of this EA expressed that commercial aircraft flights could present concerns about cumulative impacts on wildlife when considered together with WS-Colorado aerial PDM overflights. However, most such flights occur at such high altitudes (generally more than 30,000 feet), that they present virtually no potential to disturb wildlife, and we are unaware of any scientific evidence to the contrary. Therefore, we conclude such flights have no potential to contribute to cumulative impacts on wildlife that are affected by or exposed to WS-Colorado aerial PDM overflights.

There is no obvious "threshold" of significance when it comes to the cumulative effects of overflights on wildlife. Our analysis and the considerable analysis of ANG (1997) show that, despite considerable research on numerous wildlife species, no scientific evidence exists which indicates any substantive adverse effects on wildlife populations will occur as a result of any of the types of low level or other overflights that do or may occur in Colorado. WS-Colorado's past and future aerial PDM activities that have occurred within the same areas flown by military training flights are an inconsequential addition to what has already been found by analysis in an EIS to have little to no potential for causing adverse impacts on any wildlife species populations, despite the fact that the military training flights are far more numerous and produce far greater noise levels than the small aircraft used by WS-Colorado. Aerial PDM overflights by non-WS entities are too few in frequency and geographic scope to suggest any possibility of adding significantly to any cumulative adverse effects. The evidence from available studies, particularly those involving military aircraft, suggests that adverse effects do not occur even when flights are far more frequent than when private or WS-Colorado aerial PDM activities occur in specific areas.

The duration, frequency, and geographic scope of WS-Colorado's aerial PDM activities in Colorado are very low. Even the lands most heavily flown in Colorado were exposed to aerial PDM on less than 5% of the days of any one year. And given that average flight times were less than 1 hour per day, total flight times on the most heavily flown land constituted less than 0.2% of the year. On the basis of land area flown, <1% of Colorado was exposed to some level of aerial PDM in a typical year. We expect similar or potentially moderately higher levels of aerial PDM in the future under Alternative 1. Even if such overflights were to increase three-fold in the future, available scientific evidence as discussed in this chapter indicates that wildlife would not be adversely affected because most species are tolerant of or habituate to overflights. WS-Colorado's standard practice of avoiding concentrations of wildlife during aerial PDM activities further lessens the already low to nonexistent potential for such flights to adversely affect their populations.

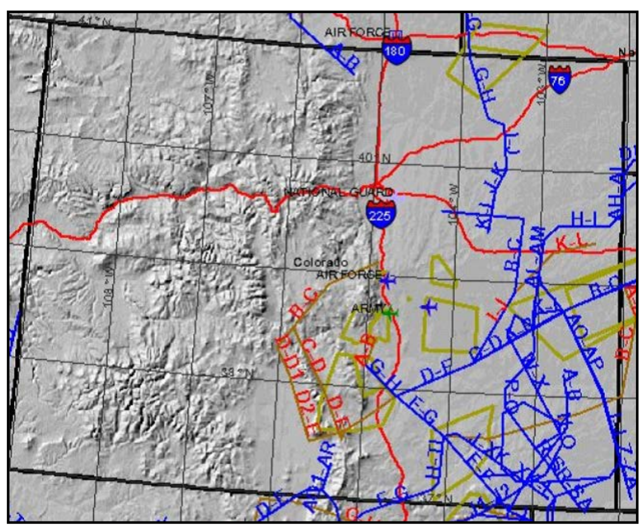


Figure 3-5. Military operations areas (tan outlined polygon areas) and training flight routes (lines with hyphenated letter designations) in Colorado. Red lines are interstate highways (map obtained @ http://www.usahas.com/bam/).

There is considerable scientific evidence presented herein that overflights do not adversely affect wildlife. Thus, we conclude that aerial overflights by WS-Colorado under Alternative 1 will have no impacts on wildlife, and that even when added to other types of overflights, such cumulative impacts would be negligible or non-existent.

3.2.1.9 Summary of Direct, Indirect, and Cumulative Impacts on Non-target Species Under Alternative 1

Direct impacts of PDM conducted by WS-Colorado on non-target wildlife species are negligible due to the low number of non-target animals that would likely be taken under this Alternative.

PDM conducted by WS-Colorado may have the potential to marginally benefit several federal and state listed T&E species. The benefits from PDM would likely be to individuals, rather than local populations. These species include the black-footed ferret, piping plover, least tern, plains sharp-tailed grouse, lesser prairie-chicken, and Gunnison's sage-grouse. Management of coyotes would benefit introduction of black-footed ferrets by increasing survival of released animals. Piping plover and least tern populations have benefitted from red fox and raccoon removal by increasing survival of nesting hens and juveniles, resulting in higher productivity and population growth. For the 3 prairie grouse species, habitat loss is the primary cause of population decline, and lower habitat quality makes these species susceptible to predation.

PDM conducted by WS-Colorado under this Alternative is expected to result in no indirect impacts to non-target species. While mountain lions selectively prey on mule deer with chronic wasting disease there were no benefits accumulated in the reduction of disease prevalence in Colorado mule deer. Cumulative impacts under this Alternative are also expected to be negligible. Private citizens probably take more non-target wildlife than WS-Colorado due to less training and experience. Even with this additional take by private citizens, cumulative impacts on non-target populations is negligible. CPW monitors non-game wildlife populations statewide, and would take corrective action if negative impacts were detected.

Under Alternative 1, there would be no significant cumulative impacts on non-target species populations in Colorado, including T&E species and other sensitive species.

3.2.2 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

Direct, Indirect, and Cumulative Impacts: Under Alternative 2, WS-Colorado would not conduct preventive operational PDM. For many individual damage situations, this alternative would be similar to the current program because producers often do not contact WS-Colorado until damage has already occurred. WS-Colorado conducts preventive control only for coyotes, because other species cause only sporadic and unpredictable damage. WS-Colorado conducts preventive damage management for coyotes where the area has had historic damage, and the coyote population level is such that damage is expected to reoccur. Preventive damage management for coyotes is often conducted with aerial PDM. Wagner and Conover (1999) concluded that the need of traps, snares, and M-44's for corrective control was lower at sites with preventive aerial PDM than sites without preventive aerial PDM. Foothold traps, snares, and M-44s have a higher risk of capturing a non-target species than aerial PDM. Therefore, WS-Colorado is likely to take slightly more non-target animals under Alternative 2. However, this increase in non-target take would be minor, and would not significantly impact non-target species populations.

This alternative would also have the potential for increased non-target take from private individuals. Livestock producers who are anticipating damage in historic loss areas might become frustrated with WS-Colorado's failure to prevent predator damage from occurring, and turn elsewhere for assistance. This would result in less experienced persons implementing PDM methods, leading to increased take of non-target wildlife (potentially including T&E species) than under Alternative 1. Private individuals would not be restricted by APHIS-WS protective measures such as APHIS-WS's self-imposed restrictions (*e.g.*, not setting traps closer than 30 feet to livestock carcasses to avoid capturing scavenging birds, and using pan-tension devices to exclude smaller animals). Slightly more non-targets, potentially including T&E species, are likely to be taken under this alternative than under Alternative 1, but less than under Alternatives 3 and 4. This slight increase in non-target take would not likely result in any significant negative impact on non-target species populations. Under Alternative 2, there would be no significant cumulative impacts on non-target species populations in Colorado.

3.2.3 Alternative 3 - Alternative 3 – WS-Colorado Provides Technical Assistance Only.

Direct, Indirect, and Cumulative Impacts: Under Alternative 3, WS-Colorado would not to conduct direct operational PDM. Therefore, WS-Colorado would not have any direct impact on non-target or T&E species. Under this alternative, CDA and CPW would likely provide some level of professional assistance with PDM. Private PDM efforts would likely increase. This would result in less experienced persons implementing PDM methods, leading to increased take of non-target wildlife (potentially including T&E species) than under Alternative 1. Private individuals would not be restricted by APHIS-WS protective measures such as APHIS-WS's self-imposed restrictions (*e.g.*, not setting traps closer than 30 feet to livestock carcasses to avoid capturing scavenging birds, and using pan-tension devices to exclude smaller animals). WS-Colorado would be able to mitigate some of the potential increase in non-target take by providing technical assistance. More non-targets, potentially including T&E species, are likely to be taken under this Alternative than under Alternatives 1 and 2, but less than under Alternative 4. This increased non-target take would not likely result in any significant negative impact on non-target species populations. Under Alternative 3, there would be no significant cumulative impacts on non-target species populations in Colorado.

3.2.4 Alternative 4 – No PDM by WS-Colorado.

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Colorado would not provide assistance with PDM and, therefore, WS-Colorado would have no effect on non-target or T&E species from the use of PDM methods. CPW and CDA would probably provide some level of professional PDM assistance, and would take minimal numbers of non-targets. Private efforts to reduce or prevent depredations would increase the most under this alternative. This would result in less experienced persons implementing PDM methods leading to a greater take of non-target wildlife (potentially including eagles and T&E species). Private individuals would not be restricted by APHIS-WS protective measures such as APHIS-WS's self-imposed restrictions (*e.g.*, not setting traps closer than 30 feet to livestock carcasses to avoid capturing scavenging birds or using pan-tension devices to exclude smaller animals). Improper use of chemical toxicants (both legal and illegal) by some entities would likely result in increased non-target take, potentially including eagles and T&E species. Private landowners would likely increase the number of trapping exemptions claimed, requiring more time and effort by CPW personnel. Alternative 4 would likely result in more non-target take than under any of the other Alternatives considered in detail. However, this level of non-target take would not be likely to result in significant negative impacts to non-target species populations. Under Alternative 4, there would be no significant cumulative impact on non-target species populations in Colorado.

3.3 Issue C: Impacts on Ecosystem Function

Biodiversity and Ecosystem Resilience: Biodiversity refers to the variety of species within an ecosystem. Ecosystem resilience refers to the magnitude of disturbance that can be absorbed before the system redefines its structure by changing the variables and processes which control behavior (Gunderson 2000). Predators, particularly apex predators, can have a pronounced impact on biodiversity and ecosystem resilience (Estes *et al.* 2011). In diverse ecosystems, there is a degree of redundancy in the roles species play within the different ecological levels (*e.g.,* apex predators, mesopredators, herbivores, plants, decomposers). In general, ecosystems that are less complex in terms of biodiversity and trophic levels, are more susceptible to adverse impacts and stressors such as climate change, disease outbreaks, introduction of invasive species, etc. In other words, such less complex ecosystems have lower ecosystem resilience (Beschta *et al.* 2013, Crooks and Soulé 1999, Ritchie and Johnson 2009, Estes *et al.* 2011, Bergstrom *et al.* 2014).

Predators directly impact ecosystems through predation and indirectly through exclusion/reduction in populations of other predators/mesopredators, and alteration of prey behavior and habitat use. Theses impacts, both direct and indirect, affect the abundance of prey species and alter impacts these species have on other levels of the food web (see discussion of trophic cascades below; Prugh *et al.* 2009, Ritchie and Johnson 2009, Estes *et al.* 2011, Wallach *et al.* 2010, Miller *et al.* 2012). Wallach *et al.* (2010) showed that increases in dingo populations (due to the absence of exclusion and poison baiting) resulted in decreases in mesopredators and generalist herbivores, and increases in small and intermediate-weight mammals. Allowing predator populations to achieve a degree of social stability (the presence of packs and associated territoriality) has also been identified as important, because it establishes natural population control at sustainable levels. The complete loss of apex predators from an ecosystem can reduce biodiversity and shorten the food web length in the system, which may alter the presence and abundance of mesopredators, increase the intensity of herbivory, and ultimately impact the abundance and composition of plant communities, soil structure, nutrients, and even physical characteristics of the environment (Berger *et al.* 2001, Beschta and Ripple 2006, Ripple and Beschta 2006, Prugh *et al.* 2009, Estes *et al.* 2011). Presence of native predators in a healthy ecosystem may also improve the ability of the system to resist adverse impacts of invasive species.

Trophic Cascades and Mesopredator Release: A trophic cascade is an indirect ecological effect that occurs when one trophic level is modified to an extent that it affects other trophic levels in a food chain or web. In a simple example, predators, their herbivore prey, and plants that provide food for the herbivores are three trophic levels that interact in a food chain. The presence of the predator causes reductions in prey populations or causes the prey population to alter its use of habitat which, in turn, impacts plant community composition and health. Depending on the nature of the impact and the prey species, changes in vegetation and prey behavior can have impacts on abiotic factors such as soil compaction, soil nutrients, and river morphology (Beschta and Ripple 2006, Naiman and Rogers 1997). In the Midwest, changes in coyote activity were documented to impact white-tailed deer activity and plant community composition (Waser *et al.* 2014). However, as with most ecosystems, the nature and magnitude of these types of relationships varies. For example, Maron and Pearson (2011) found no evidence that the presence of vertebrate predators fundamentally affected primary production or seed survival in a grassland ecosystem.

Mesopredator release is a trophic cascade where the removal of an apex predator (*e.g.*, wolves or coyotes) results in increased populations of smaller predator(s) (*e.g.*, fox, raccoons, feral cats), which may produce different impacts on prey populations and other trophic levels (Prugh *et al.* 2009, Brashares *et al.* 2010, Miller *et al.* 2012). For example, the presence of coyotes in an area has been shown to limit the density of smaller predators which may prey more heavily than coyotes on songbirds, ground nesting birds such as ducks and game birds, and some rodents (Levi and Wilmers 2012, Miller *et al.* 2012). Also, recovery of wolf populations and associated long-term declines in coyote populations have been documented to result in an increase in survivorship of pronghorn deer fawns (Berger and Conner 2008). And carnivores such as badgers, bobcats, and fox have also been shown to increase in number when coyote populations are reduced (Robinson 1961, Nunley 1977, Crooks and Soulé 1999).

3.3.1 Alternative 1 – Proposed Action/No Action Alternative—Continue WS-Colorado PDM Program.

3.3.1.1 Impacts on Biodiversity and Ecosystem Resilience.

Some members of the public have raised concerns that PDM actions by WS-Colorado may result in unintentional adverse impacts on biodiversity and ecosystem resilience by eliminating or reducing predator populations (Bergstrom *et al.* 2014, Estes *et al.* 2011).

However, Under Alternative 1, WS-Colorado PDM activities would occur in localized areas and would not be conducted throughout the year, as previously discussed. This includes corrective PDM, which occurs for short periods after damage had occurred, and preventive PDM, which would likely occur for short periods during the time of year when addressing predators would be the most beneficial to reducing threats of damage (*e.g.*, the period of time immediately preceding and during calving and lambing in the spring). On average, WS-Colorado conducts PDM under agreements which comprise 2.814 million acres annually, which is 4.2% of the land area of Colorado. WS-Colorado only conducts activities on a small portion of the land acres allowed under MOUs, annual WPs, Work Initiation Documents, or other comparable documents. As discussed in Chapter 1, WS-Colorado typically conducts PDM on only 1/5 of the land area under agreement in any given year (WS 1997); thus, we anticipate that WS-Colorado would conduct PDM on less than 1% of the land area of Colorado. In addition, the number of predators taken annually by WS-Colorado and other entities is a small percentage of the estimated populations of those species in the state. Under Alternative 1, we anticipate similar levels of work and similar levels of take; therefore, WS-Colorado does not anticipate any impact on biodiversity or associated ecosystem resilience.

Most evaluations of the impacts of predator removal or loss on biodiversity involve the complete removal of a predator species from the ecosystem for multiple years (*e.g.*, Berger *et al.* 2001, Beschta and Ripple 2006, Frank 2008, Gill *et al.* 2009). WS-Colorado's actions will not result in long-term extirpation or eradication of any wildlife species, so findings of most of these studies are not relevant to the proposed action. WS-Colorado operates in accordance with international, federal, and state laws and regulations enacted to ensure species viability. WS-Colorado operates on a relatively small percentage of the land area of Colorado, and take is only a small proportion of the total population of any species (Section 3.1). The analyses in this EA and in GAO (1990) indicate that the impacts of the current WS-Colorado program on biodiversity are not significant statewide or nationally. Any reduction of a local population or groups would be temporary because natural immigration from adjacent areas or reproduction from remaining animals would replace the animals removed, unless actions are taken by the landowner/manager to make the site unattractive to the target species. The limited nature of WS-Colorado take of most predator species listed in this EA is so low that substantive shifts in population age structure are not anticipated (Section 3.1). Below, we analyze the potential for such impacts due to the take of coyotes, because they are the species most commonly taken by WS-Colorado.

Henke (1992, Henke and Bryant 1999) documented decreases in species richness and rodent diversity and increases in relative abundance of badgers, bobcats, and gray foxes in areas of Texas where year-round coyote removals resulted in a sustained 48% reduction in the local coyote population. However, the year-round level of coyote removals in these studies does not occur during normal PDM operations which would occur in Colorado under Alternative 1. Similarly, the degree of PDM (exclusion or sustained year-round intensive population reduction efforts via the use of toxicants) was far greater in the study by Wallach *et al.* (2010) than PDM efforts by WS-Colorado. This combined with the fact that cumulative take of coyotes is a low percentage, between 21% and 45% of Colorado's estimated coyote population, and WS-Colorado kills a much smaller percent of the population (1.1-1.7%) than the cumulative take, indicates that PDM has a minimal effect on the overall ecosystems in Colorado (Table 3-3). Based on findings of Gese (2005), both the number of coyotes and the number of packs in areas with PDM levels similar to that of WS-Colorado had returned to pre-control levels within 8 months. Although there was evidence of a reduction in the average age of the population, there was no evidence that this resulted in an increase in coyote densities above pre-control levels. Based on this information, we conclude that the impacts of the current WS-Colorado program are not of sufficient magnitude or scope at the local or state level to adversely impact biodiversity or ecosystem resilience. Under Alternative 1, we anticipate similar levels of PDM and take; thus, there would be no impact on biodiversity or ecosystem resilience.

3.3.1.2 The Potential for Trophic Cascades and Mesopredator Release.

Some individuals have expressed concerns that activities such as WS-Colorado's PDM would cause disruptions to trophic cascades or irruptions in prey populations, such as rodents or rabbits, by eliminating or substantially reducing top predators (Prugh *et al.* 2009, Crooks and Soule´ 1999, Ritchie and Johnson 2009, Estes *et al.* 2011, Bergstrom *et al.* 2014). WS-Colorado has reviewed these studies but, for the most part, they are not applicable to the types of PDM proposed for Colorado, because they involve the complete absence of apex consumers from the system (*e.g.*, Berger *et al.* 2001, Beschta and Ripple 2006, Frank 2008, Gill *et al.* 2009, Ripple *et al.* 2012, Gill *et al.* 2009, Ripple *et al.* 2013; Estes *et al.* 2011). In some instances, impacts have also been observed in cases where the predators were substantially reduced over an extended period of time (*e.g.*, Henke 1992, Henke and Bryant 1999 and Wallach *et al.* 2010 discussed above).

The data on the impacts of coyotes and coyote removal on prey populations are mixed. In two studies conducted in south Texas (Beasom 1974, Guthery and Beasom 1977), intensive short-term predator removal was employed to test the response of game species to reduced coyote abundance. At the same time, rodent and lagomorph species were monitored. A marked reduction in coyote numbers apparently had no notable effect on the populations of rabbits or rodents in either study. Similarly, Neff *et al.* (1985) noted that reducing coyote populations on their study area in Arizona to protect pronghorn antelope fawns had no apparent effect on rodent or rabbit populations.

Wagner and Stoddart (1972) noted that coyote predation is a significant source of mortality in jackrabbit populations, and may have played an important part in jackrabbit population trends. But they made no connections between PDM and jackrabbit mortality or coyote populations. Moreover, the coyote population in this study was subject to much more sustained and intensive control (coyotes were taken through use of aerial PDM, trapping for bounties and pelts, and the use of 1080 poison bait stations that were placed in fall and recovered in spring) than is expected to occur under the current WS-Colorado PDM program.

Wagner (1988) reviewed literature on PDM impacts on prey populations, and concluded that such impacts vary by location. In some ecosystems, prey species, such as snowshoe hares, increased to the point that vegetative food sources were depleted, despite predation. In others, coyotes might limit jackrabbit density, whereas food shortages do not (Wagner 1988, Stoddart *et al.* 2001). Wagner and Stoddart (1972) reported that coyote predation was a major source of jackrabbit mortality in the Curlew Valley of Utah that may have caused a decline in the local jackrabbit population.

Henke (1995) reviewed literature concerning coyote-prey interactions and concluded that short-term coyote removal efforts (<6 months per year) typically did not result in increases of small mammal prey species populations. This finding is supported by Gese (2005) in which local coyote removal of up to 60 to 70% of the population for two consecutive years in a 131 mi^2 study had no observable impact on local lagomorph abundance. Some of the reason for this lack of impact may have been attributable to the fact that coyote pack size and density in the project area returned to pre-removal levels within 8 months of removal. Henke (1995) also concluded that long-term intensive coyote removal (nine months or longer per year) could, in some circumstances, result in changes to the rodent and rabbit species composition in the area where removals occurred, which could lead to changes in plant species composition and forage abundance. This conclusion was based on a previous study (Henke 1992) conducted in the rolling plains of Texas that involved one year of pretreatment and two years of treatment. Removals occurred year-round and resulted in a sustained reduction in the coyote population of approximately 48%. After the initiation of coyote removal, species richness and rodent diversity declined in treatment areas and relative abundance of badgers, bobcats, and gray foxes increased. However, sustained reduction in coyote populations (and presumably other mesopredators) after restoration of wolf populations resulted in increases in the number of voles within 3 km of wolf dens (Miller *et al.* 2012).

The Gunnison Sage-grouse Rangewide Steering Committee (2005) cited studies of red fox and coyote home ranges in duck breeding areas of North Dakota as evidence that red fox numbers may increase if coyote numbers are reduced. Sargeant *et al.* (1984) reported on the effects of red fox predation on breeding ducks. Their data were collected when coyote populations were presumably suppressed by widespread use of predacides, and he notes that at the time (1968-73), "*[c]oyote populations in most of the midcontinent area appear to be suppressed by man*." The authors noted an inverse relationship between red fox and coyote populations and speculated that "*protection of coyotes will result in expansion of local or regional populations that in turn will cause reductions in fox populations.*" They inferred that this will reduce predation on upland nesting ducks. Sargeant *et al.* (1987) reported on spatial relationships between coyotes and red foxes and showed that home ranges of fox families did not overlap the core centers of coyote home ranges on a North Dakota study site. Although none of their radio collared foxes were killed by coyotes in their study, they hypothesized that red foxes tended to avoid coyote territories, presumably because of the fear of being killed by coyotes. Thus, they inferred that the red fox population would increase if the coyote population was reduced, because the removal of territorial coyotes would create vacant coyote territories that could then become occupied by red foxes.

However, other research has demonstrated that the presence of coyotes does not completely displace red foxes. Voigt and Earle (1983) verified that red fox travel through coyote areas during dispersal, but did not establish there. They also reported that "*individual foxes and coyotes can occur in close proximity to each other along territory borders and when coyotes travel into fox areas.*" They also noted that "*fox-coyote range overlap near borders was similar to fox-fox range overlap near borders and that coyotes do not completely displace foxes over areas.*" Gese *et al.* (1996) reported that coyotes tolerated red foxes about half of the time when encountered in Yellowstone National Park, although they would sometimes show aggression toward and kill the foxes.

Other studies suggest that coyote territories would not remain vacant for very long after the coyotes are removed. Gese (1998) noted that adjacent coyote packs adjusted territorial boundaries following social disruption in a neighboring pack, thus allowing for complete occupancy of the area despite removal of breeding coyotes. Blejwas *et al.* (2002) noted that a replacement pair of coyotes occupied a territory in approximately 43 days following the removal of the territorial pair. Williams *et al.* (2003) noted that temporal genetic variation in coyote populations experiencing high turnover (due to control) indicated that "*localized removal did not negatively impact population size*…." Considering the level of coyote removals that WS PDM activities achieve (less than 2% of the estimated population), it is most likely that coyote populations are probably not impacted enough, even at the individual territorial level, to create the vacant territories that would theoretically allow red fox populations to increase substantially at the local level based on the North Dakota studies discussed above.

Ripple and Beschta (2007) and Ripple and Beschta (2012) examined a trophic cascade involving wolves, aspen and elk in Yellowstone National Park. The study documented the first significant growth of aspen on the northern winter range in the park (Ripple and Beschta 2007). They claimed their findings were consistent with a behaviorally-mediated and density-mediated trophic cascade. They presented data showing an increasing wolf population with a concurrent decrease in the elk population, and increase in the growth of aspen. Additionally, as elk populations decreased, bison and beaver increased, possibly due to increased forage from grass and aspen growth (Ripple and Beschta 2012). However, while Ripple and Beschta (2007, 2012) documented population responses from bison and beaver, and growth of grasses and forbs during a period of elk population decline, the elk population decline was not from wolf predation. Vucetich *et al.* (2005) and White and Garrott (2005) analyzed the extent wolf predation contributed to elk population decline from 17,000 to 8,000 animals on northern range in Yellowstone National Park. They determined that the elk population declined due to legal hunting outside the park and weather. Wolf predation on elk in the park was compensatory (Vucetich *et al.* 2005). White and Garrott (2005) also documented the large effect legal hunting had on reducing the elk population in Yellowstone National Park. Additionally, they recommended a reduction in female elk harvest to not accelerate the decrease in elk numbers. Whereas Beschta and Ripple (2007) documented a correlation, these other studies show that is was not a cause and effect.

An impact sustained over a period of decades was found at a site in Zion National Park which was largely avoided by cougars due to high human activity (Ripple and Beschta 2006). The decrease in cougars resulted in increases in mule deer, and associated increases in herbivory on riparian cottonwoods. Ultimately, this resulted in decreased cottonwood regeneration in the riparian area, increases in bank erosion, and reduction in both terrestrial and aquatic species abundance. However, this is another example of dramatic and long-term population reduction, which is not analogous to WS-Colorado PDM.

As discussed in this EA, WS-Colorado only conducts PDM when and where it is needed. When direct management of a depredating animal(s) is needed, efforts focus on management of the specific depredating animal or local group of animals. WS-Colorado does not strive to eliminate or remove predators from any area on a long-term basis, no predators or prey would be extirpated, and none would be introduced into an ecosystem. As discussed in detail in Sections 3.1 and 3.2, impacts are generally temporary and in relatively small or isolated geographic areas compared to overall population distributions. Therefore, we conclude that the impacts of WS-Colorado actions are not of sufficient magnitude or scope to result in ecosystem-level shifts in trophic cascades. Most removal of predators for PDM by WS-Colorado involves removal of a small percentage of individuals of the total population from relatively isolated locations. This level of removal is not of sufficient magnitude to result in substantive reductions in predator species abundance. The only species taken by the WS-Colorado program in sufficient numbers to result in substantive short-term local population reductions are coyotes.

Given the patchy and limited scope of WS-Colorado PDM actions, repopulation of areas where PDM is conducted occurs relatively quickly, often within a year of the removals. As noted above in the section on biodiversity and ecosystem resilience, removals are not expected to result in long-term reductions in pack density or the number of coyotes, despite potential reductions in the age structure of the population (Gese 2005).

In the study by Gese (2005) a combination of aerial PDM and trapping removed approximately 44-61% and 51-75%, respectively, of an estimated coyote population from a 131 mi^2 project over the first and second year of a two-year study. Removals resulted in substantial reductions in coyote pack size and an associated decrease in density, but both pack size and density rebounded to pre-removal levels within 8 months. Radio collar data and shifts in age structure support the hypothesis that the coyotes colonizing the area after control were non-territorial individuals, which included yearlings from adjacent reproducing pairs of coyotes. The coyote population in the removal area had a younger age structure than the control area. Home range size did not vary for coyotes remaining after coyotes in adjacent territories were removed. Mean litter size did not differ substantially after the first year of winter and spring coyote removals, but increased the second year. Average litter size was correlated to the density of coyotes entering the breeding season. Increases in available prey the second year of the removals also have influenced coyote reproductive success, with a significant positive correlation between prey per coyote and litter size. However, lagomorph (*i.e.*, rabbits) abundance increased in both the area with coyote removal and the control area without coyote removal and was not the result of coyote removals. The seasonality of the coyote removal in the Gese (2005) study was similar to that which occurs in WS-Colorado, but the proportion of the coyote population removed in the Gese (2005) study was likely higher than typically occurs in Colorado.

Similarly, red foxes are highly mobile, and PDM actions are patchy in nature. Because of strong compensatory density feedback, primarily through immigration (Lieury *et al.* 2015), removals are not expected to result in long-term reductions in fox. Given the above factors, we believe it is unlikely that PDM actions by WS-Colorado would result in unintended adverse impacts on ecosystems through perturbation of trophic cascades, or specifically, mesopredator release.

3.3.1.3 Impact of PDM on diseases of prey populations.

Mountain lions have been shown to selectively prey on mule deer with chronic wasting disease (CWD) (Miller *et al.* 2008, Krumm *et al.* 2010), as discussed in Section 1.17.5.1. Removal of infected individuals from a population by predators, or by testing and culling, has been theorized as an effective control strategy for CWD (Gross and Miller 2001, Packer *et al.* 2003, Wolf *et al.* 2004). However, Miller *et al.* (2008) concluded that, in spite of selective predation by mountain lions, predation did not decrease CWD transmission. Moreover, CWD has spread since the 1980s and now is detected in ungulates in 84 hunting license units or about half of Colorado (CPW 2018). Thus, Miller *et al.* (2008) and Krumm *et al.* (2009) concluded that CWD has persisted in mule deer populations despite selective mountain lion predation.

Wild *et al.* (2011) used a mathematical model to evaluate the potential elimination of CWD by gray wolves selectively predating on infected ungulates. The model concluded a rapid decline in CWD prevalence and eventual elimination in a closed population. Whereas the model is helpful in exploring possibilities, the natural environment is an open population. Wild *et al.* (2011) identified that continued reintroduction of CWD in an open population would result in a lower prevalence of CWD, but elimination was unachievable. It would be beneficial to evaluate if wolves can reduce the prevalence of CWD where the disease and wolves occur concurrently.

Some scientists have suggested that wolves might decrease the spread of brucellosis in wild elk and bison because the wolves would be expected to eat aborted fetuses, thereby removing infectious material from the environment (Johnson 1992), or decrease transmission among elk due to population control and behavior modification (Cross *et al.* 2010). However, we are aware of no credible evidence to support these speculations. In fact, some researchers have reported findings that wolves in Yellowstone do not reduce the risk of brucellosis transmission in wild elk and bison (Proffitt *et al.* 2010), or findings which suggest that wolves might increase the risk of brucellosis transmission among elk (Proffitt *et al.* 2009).

The best available science indicates that predator removal would not impact diseases of prey populations, because predators do not control disease in prey populations. This is especially true for the removal of predators during PDM under Alternative 1, due to the small fraction of predators removed, and the lack of any significant impact on their populations, as discussed in Section 3.1.1.

3.3.1.4 Impact of PDM on prey populations.

Rabbit and rodent populations normally fluctuate substantially in multi-year cycles. Keith (1974) concluded that: 1) during cyclic declines in prey populations, predation has a depressive effect, further decreasing prey populations and holding them for some time at relatively low densities; 2) prey populations may escape this low point when predator populations decrease in response to low prey populations; and 3) because rabbit and rodent populations increase at a faster rate than predator populations, factors other than predation must initiate the decline in populations.

Wagner and Stoddart (1972) and Clark (1972) independently studied the relationship between coyote and black-tailed jackrabbit populations in northern Utah and southern Idaho. Both concluded that coyote populations respond to an abundance of jackrabbits by shifting their diet toward jackrabbits. Conversely, when a broad range of prey species is available, coyotes generally feed on all species available; therefore coyote populations may not vary with changes in the availability of a single prey species (Knowlton 1964, Clark 1972).

Wagner (1988) reviewed the impacts of predators on prey populations, and concluded that such impacts vary with the locale. In some ecosystems, prey species such as snowshoe hares increase to the point that vegetative food sources are depleted despite predation. In others (*e.g.*, jackrabbits in the Great Basin), coyotes may limit jackrabbit density, and food shortages do not seem to limit jackrabbit abundance. Wagner and Stoddart (1972) reported that coyote predation was a major source of jackrabbit mortality and may have caused a decline in jackrabbit numbers in the Curlew Valley in Utah.

Henke (1995) reviewed literature concerning coyote-prey interactions and concluded that short term (≤6 months per year) coyote removal typically does not result in increases in small mammal prey species populations, but that longer term intensive coyote removal (9 months or longer per year) can in some circumstances result in changes in rodent and rabbit species composition, which may lead to changes in plant species composition and forage abundance. The latter conclusion was based on one study (Henke 1992) which was conducted in the rolling plains of Texas. Whether such changes would occur in all ecosystems is unknown. But even if they would, the following mitigating factors should serve to minimize these types of environmental impacts:

(1) Most PDM actions in localized areas of the State would not be year round, but would occur for short periods after damage occurs (corrective control), or for short periods (typically less than 20 days per year) just before and during calving and lambing seasons (preventive control).

(2) WS-Colorado typically conducts PDM in less than 2.5% of the land area of Colorado in any year, and takes only a small percentage (< 2%) of the state's population of coyotes in any one year. Thus, any potential impacts would be small or negligible, and limited to isolated areas.

Other prey species of coyotes include white-tailed, mule deer, and pronghorn (antelope). Local short term predator population reductions may enhance deer and pronghorn populations (see Chapter 1). This could be either a beneficial or detrimental effect, depending upon whether local deer populations were at or below the capacity of the habitat to support them. However, because WS-Colorado only conducts PDM on less than 1% of the land area of the state and takes less than 2% of the coyote population in any one year, it is unlikely that positive effects on deer or pronghorn populations would be significant, except in isolated areas where PDM was designed to produce such results, at the request of CPW. If CPW or a Tribe requested coyote removal for the purpose of enhancing pronghorn or deer herds, an increase in local populations would be desired and considered a beneficial impact on the human environment. In those situations, it is likely that coyote control would be more intense, and longer-lasting, but would end when herd management goals were met. Even in such a scenario, it is unlikely that impacts would be significant over major portions of the state.

In general, it appears that predators prolong the low points in rodent population cycles and spread the duration of the peaks. Predators generally do not "control" rodent populations (Keith 1974, Clark 1972, Wagner and Stoddart 1972). It is more likely that prey abundance controls predator populations, especially a species such as the lynx which exhibits a classic predator-prey relationship with the snowshoe hare. The USFWS (1979, p. 128) concluded that "*[APHIS-WS] Program activities have no adverse impacts to populations of rodents and lagomorphs.*"

3.3.2 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

Direct, Indirect, and Cumulative Impacts: Under Alternative 2, WS-Colorado would not to conduct preventive operational PDM. For most damage situations, this alternative would be similar to Alternative 1, because WS-Colorado only conducts preventive control for coyotes, where the area has had historic damage, and the coyote population is such that damage is expected to reoccur. Preventive damage management for coyotes is often conducted with aerial PDM, which would be a less effective tool in late spring or summer, after damage had occurred. Under this Alternative, WS-Colorado would likely increase the use of traps, snares, and M-44's for corrective control in these areas. As analyzed for Issue A (Impacts on Target Predator Species Populations; Section 3.1.2), the end result under Alternative 2 would be approximately 10% lower take of coyotes for PDM (all PDM take, including take by WS-Colorado and private entities), or about 200 fewer coyotes per year. Under this Alternative, maximum likely cumulative take of coyotes would be approximately 47,138, compared to 47,338 under Alternative 1, which is 0.4% lower. This difference is negligible. The vast majority (96%) of cumulative coyote harvest in Colorado is from sportsman harvest (see Section 3.1.1 and Table 3-3 for analysis). This negligible difference in the cumulative number of predators taken in Colorado would not be likely to have any changes in potential impacts on ecosystem function, including biodiversity, ecosystem resilience, trophic cascades, mesopredator release, and prey populations.

Increased non-target take would be expected under Alternative 2 (see Section 3.2.2 for analysis). However, this increase would not be expected to significantly impact ecosystem function.

Cumulative impacts on ecosystem function under Alternative 2 would be the same as those under Alternative 1: there would be no significant impacts to ecosystem function.

3.3.3 Alternative 3 – WS-Colorado Provides Technical Assistance Only.

Direct, Indirect, and Cumulative Impacts: Under Alternative 3 WS-Colorado would not conduct direct operational PDM. Therefore, WS-Colorado would not have any direct impact on ecosystem function. Under this alternative, CDA and CPW would likely provide some level of professional assistance with PDM, and private PDM efforts would likely increase. The cumulative harvest of target predator species under this Alternative would likely be negligibly lower (<1%) than under Alternative 1 for all species except black bears and mountain lions, because the vast majority of cumulative take for these species is sportsman harvest, which would not be different. Because CPW intensively manages black bears and mountain lions, cumulative take for these species would be virtually identical to that under Alternative 1; CPW would continue to manage these species for cumulative take, according to their targets.

Although technical assistance from WS-Colorado might lead to more selective use of PDM methods by private parties than that which could occur under Alternative 4, private efforts to reduce or prevent depredations would likely result in less experienced persons implementing PDM methods, leading to greater take of non-target wildlife and potentially T&E species, as discussed in Sections 3.2.2 and 3.2.3). This would likely result in a moderate increase in non-target take under Alternative 3.

These differences in target and non-target take would not change our impact analyses under Alternative 1, including potential impacts on biodiversity, ecosystem resilience, trophic cascades, mesopredator release, and prey populations (Section 3.3.1). Under Alternative 3, there would be no significant cumulative impacts on ecosystem function.

3.3.4 Alternative 4 – No PDM by WS-Colorado.

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Colorado would not provide any direct operational work, or technical assistance with PDM. Therefore, WS-Colorado would have no direct effect on ecosystem function. However, predator take for PDM would still occur because predator damage would still occur. The cumulative harvest of target predator species under Alternative 4 would likely be negligibly lower (<1%), or about the same as that analyzed under Alternative 1 (see Section 3.1.4 for discussion and analysis).

Non-target take would likely increase moderately under Alternative 4, due to increased PDM by private entities with less experience, less professionalism, less access to the most selective tools, and less oversight, as discussed in Section 3.2.4.

These differences in target and non-target species take would not alter our analyses of impacts on ecosystem function under Alternative 1, including potential impacts on biodiversity, ecosystem resilience, trophic cascades, mesopredator release, and prey populations (Section 3.3.1). Under Alternative 4, there would be no significant cumulative impacts to ecosystem function.

3.4 Issue D: Human and Pet Health and Safety

3.4.1 Alternative 1 - Continue the Current Federal PDM Program.

The use of PDM methods by WS-Colorado poses little potential hazard to WS-Colorado employees or to the public because all methods and materials are consistently used in a manner known to be safe. This assessment included potential risks to WS-Colorado employees, the public, non-target animals including pets. Whereas some of the materials and methods used by WS-Colorado have the potential to represent a threat to health and safety if used improperly, problems associated with their misuse have rarely occurred. This favorable record is due to training and certification programs for the use of PDM methods such as the M-44, and compliance with chemical use (mandatory licensing and annual training), firearms (mandatory firearms training every 2 years - WS Directive 2.615), and aviation safety (pilot and gunner training). The proper use of PDM methods and safety is stressed through training and policies. The risk to the public is further reduced because most WS-Colorado PDM methods are used mostly in areas where public access is limited. Additionally, warning signs are prominently posted to alert the public when and where, in the general area, toxic devices or traps are deployed. WS-Colorado coordinates with cooperators or landowners about where and when PDM methods are to be used, thereby decreasing the likelihood of conflicts with the public. APHIS-WS program chemicals are used following label directions, they are highly selective to target individuals or populations, and such use has negligible impacts on the environment. The WS-Colorado operational program properly disposes of any excess solid or hazardous waste and has been found to manage its chemicals appropriately (OIG 2015). It is not anticipated that the proposed action would result in any adverse or disproportionate environmental impacts to minority and low-income persons or populations. The issue of safety was discussed in Chapter 2, and protective measures to minimize potential impacts on safety were discussed in Section 2.11.

APHIS-WS recently conducted a series of risk analyses on the wildlife damage management activities conducted by APHIS-WS, including but not limited to PDM activities. These analyses include an introductory chapter (Chapter I, WS 2017c) which addresses employee and public safety. Other chapters address specific tools used by APHIS-WS, and address employee and public safety related to the use of those tools. These include: cage traps (Chapter II, WS 2017d), cable restraints (Chapter III, WS 2017e), foothold traps (Chapter IV, WS 2017f), aircraft use (Chapter V, WS 2017g), firearms (Chapter VI, WS 2017h), sodium cyanide, which is the active ingredient in M-44s (Chapter VII, WS 2017i), Large Gas Cartridges (Chapter VIII, WS 2017j), and nets (Chapter XIII, WS 2017k). Similar risk analyses of 24 other APHIS-WS methods have not yet been finalized, but are in progress. See Chapter I (WS 2017c) for the complete list.

These WS risk analyses have generally found that the methods used by APHIS-WS often include some inherent risk, and cite appropriate measures to mitigate the risks to employee and human safety, as well as other environmental factors, and humaneness. These measures are generally already incorporated by APHIS-WS and WS-Colorado; however, if these risk analyses determine that additional mitigation measures are warranted, WS-Colorado will implement those measures, as applicable. WS (2017c) found an annual average of 59 field injuries to APHIS-WS employees nationwide. The majority of these were minor injuries, including strained muscles/ligaments (35%), compression/contusion injuries (15%), and laceration/puncture wounds (13%). Together, these minor injuries accounted for 63% of injuries.

During FY12-16, WS-Colorado took an average of 26 coyotes and 1 red fox per year with M-44s, which is approximately 1.3% of total annual coyote take, and 1.2% of red foxes. Considering the low number of coyotes taken using M-44, non-WS-Colorado entities are likely to compensate for loss of use of M-44s through more extensive use of traps, snares, and shooting.

WS-Colorado PDM activities are also not likely to negatively affect the public in terms of "Environmental Justice" and "Executive Order 12898". "Environmental Justice" and "Executive Order 12898" relate to the fair treatment of people of all races, income and culture with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Environmental justice is a priority within USDA, APHIS, and WS. Also, all APHIS-WS activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice.

Under the current program alternative, PDM methods could be used to resolve complaints involving predators that represent a risk to public health and safety. Recent projects involving predators that represented a human health and safety risk, such as those described in 2.3.3, were effectively resolved using PDM methods such as traps and firearms.

3.4.1.1 Human Safety Consequences of Aerial PDM Accidents.

Major issues related to aviation accidents include the loss of aircraft, and risks to the public and crew members. Accidents have been associated with WS aerial operations and are a major concern to WS and to the public. APHIS-WS has recently conducted a risk analysis on the use of aircraft in wildlife damage management, including PDM to address the risks to WS personnel, the public, and the environment (WS 2017g). The use of aircraft by APHIS-WS and WS-Colorado is quite different from general aviation (GAV) use. The environment in which WS conducts aerial PDM is inherently a higher risk environment than that for GAV. Low-level flights introduce hazards such as power lines and trees, and the safety margin for error during maneuvers is diminished compared to high-level flights. The APHIS-WS and WS-Colorado aerial PDM program is more similar to the "Aerial Application" portion of GAV, which includes crop-dusting and other low-level flight. In 1998, WS commissioned an independent review of its aerial PDM operations as a result of several accidents. The panel made several recommendations to WS regarding enhanced aviation safety, and these recommendations were implemented by the development of WS's Aviation Safety Program. This program supports aerial activities, and recognizes that an aggressive overall safety and training program is the best way to prevent accidents. WS agency pilots and contractors are highly skilled and highly experienced, with commercial pilot ratings, and they have passed proficiency tests in the flight environment encountered by WS. Pilot training includes the use of simulators, and WS contract pilots are now being screened more thoroughly and held to the same standards as agency-employed pilots to help reduce their accident rate, which used to be substantially higher than that of WS-employed pilots (WS 2005). WS pilots, gunners, and ground crews are trained in hazard recognition, and shooting is only conducted in safe environments. All of these have helped to lower the WS aviation accident rate, and make aerial PDM safer for WS employees and the public. Federal aviation regulations require pilots to fly a minimum distance of 500 feet from structures and people, and all employees involved in these operations are mindful of this. Because of the remote locations in which WS conducts aerial operations, the risk to the public from aviation operations or accidents is extremely minimal.

We analyzed aviation accidents beginning in 2001 because that was when most of the independent review panel recommendations were implemented, and ending in 2010 because those were the most recent GAV figures we could find which included aerial application statistics (NTSB 2014). For the WS aviation accident analysis, we also included data from calendar years 2011-2016, due to recent accidents which warranted inclusion in our analysis. We do not have GAV data for these years, so the data are not directly comparable. Also, the accident in calendar year 2016 occurred in our federal FY 2017, which is outside of the analysis period for this EA. We included the recent WS data for transparency. The aviation industry standard for expression of accidents is the number of accidents per 100,000 hours flown, and all accident rate data will be reported this way, though the units will generally be omitted for simplicity.

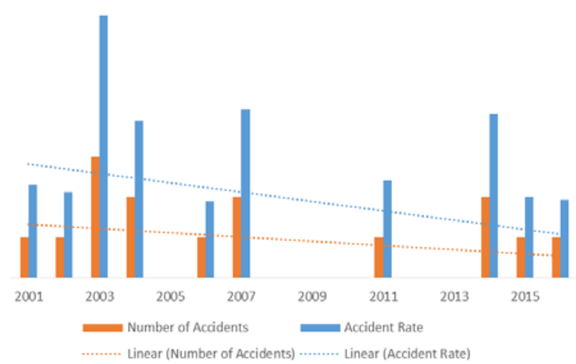
Because WS-Colorado flies such a low number of hours annually (580 hours/year on average during FY12-16), it would be statistically imprudent to analyze accidents on a statewide basis. It is more appropriate to analyze APHIS-WS aviation accidents nationwide. At the national level, APHIS-WS hours flown annually ranged from 14,452 in FY01 to as many as 26,112 in FY09. Total hours flown during FY01-16 was 267,104 with an average of 16,694. Even these number are very low compared to GAV numbers, which averaged just over 25,000,000 during this timeframe, but they provide the best basis for comparison.

Nationwide, APHIS-WS had an accident rate of 5.6 (accidents per 100,000 hours flown) during calendar year 2001-2016, which is well below the GAV rate of 6.8 (NTSB 2014). However, as noted above, the low-level flying conducted by WS is inherently more dangerous than most GAV flying. As such, this lower accident rate demonstrates WS's superior safety record over GAV. The aerial application portion of GAV had an accident rate of 7.5, which is comparable flying. WS's accident rate of 5.6 was significantly lower than this rate, which is another indication of WS's superior safety record.

Still, WS strives for zero aviation accidents, and the implementation of our Aviation Safety Program, and its Aviation Training Center, have been successful in dramatically decreasing the WS accident rate since 2001 (Figure 3-6). Both the number of accidents per year, and the accident rate (the more useful number) have been steadily decreasing since 2001. In fact, during 2008-2016, with the WS Aviation Training Center fully operational, the WS accident rate has dropped to 3.3 which is markedly lower than the general aviation rate of 6.85 during 2008-2010 (2011-2016 NTSB data are not available for direct analysis).

Some of WS's accidents have involved pilot error whereas others were directly related to mechanical failure. Of the accidents between 1996 and 2012, 14 were due to pilot error, 6 were due to mechanical failure, and 2 due to unknown causes. WS built the WS Aviation Training Center with the goal of reducing pilot error accidents to zero. Pilots are being trained to deal more effectively with different types of mechanical failures. WS complies with all Federal Aviation Administration issued Service Bulletins, Airworthiness Directives, aircraft manufacturing recalls, and similar documents. Notably, WS has been responsible for notifying the Federal Aviation Administration of 2 discrepancies in these documents, and one involving turbine engines was issued to the public in an Airworthiness Directive.

Figure 3-6. Trends of Wildlife Services aerial predator management accidents and accident rates from 2001 through 2016.



The APHIS-WS accident rate is within or below the norms of aviation and have not involved the general public. The risks are determined to be low, and expected to remain low in the foreseeable future. WS flight crews understand and accept these risks when they agree to participate in aerial PDM. WS will continue to strive to further reduce these risks.

3.4.1.2 Potential Public Safety Impacts from Aircraft Accidents.

We also considered the potential for aircraft accidents (associated with WS-Colorado's aerial PDM operations) to cause catastrophic ground fires and pollution as a result of spilled fuel and oil. Information was obtained from Mr. Norm Wiemeyer, Chief, Denver Field Office of the National Transportation Safety Board (the agency that investigates aviation accidents).

Catastrophic Ground Fires: Mr. Wiemeyer stated he had no recollection of any major fires caused by any government aircraft; he has been in his position since 1987. In addition, there are no reports of fires caused by WS aircraft in other states. The period of greatest fire danger typically occurs during the summer months, but WS ordinarily conducts few, if any, aerial PDM operations during the summer months.

Fuel Spills and Environmental Hazard from Aviation Accidents: The National Transportation Safety Board stated that aviation fuel is extremely volatile and will evaporate within a few hours or less to the point that even its odor cannot be detected (N. Wiemeyer, National Transportation Safety Board, pers. comm., 2000). Jet A fuel does not pose a large environmental problem if spilled. It is a straight chained hydrocarbon with little benzene present and microbes would quickly break-down any spill residue through aerobic action (J. Kuhn, Montana Department of Environmental Quality, pers. comm., 2001). The quantities used by WS aircraft are relatively small (52 gallon maximum in a fixed-wing aircraft and 91 gallon maximum in the helicopters used by WS), and during much of each flight the amount of fuel on board would be considerably less than these maximum amounts. In some cases, not all of the fuel would be spilled. Thus, there should be little environmental hazard from unignited fuel spills.

Oil and Other Fluid Spills: For privately owned aircraft, the aircraft owner or his/her insurance company is responsible for clean-up of spilled oils and other fluids, but only if required by the owner or manager of the property on which the accident occurred. In the case of BLM, USFS, and National Park Service lands, the land managing agency generally requires soil to be decontaminated or removed and properly disposed of. With the size aircraft used by WS, the quantities of oil capable of being spilled in any accident are small [6-8 quarts maximum for reciprocating (piston) engines and 3-5 quarts for turbine engines] with minimal chance of causing environmental damage. Aircraft used by WS are single engine models, so the greatest amount of oil that could be spilled in one accident would be about 8 quarts.

Petroleum Biodegradation: Petroleum products degrade through volatilization and bacterial action, particularly when exposed to oxygen (EPA 2000). Thus, small quantity oil spills on surface soils can be expected to biodegrade readily. Even in subsurface contamination situations involving underground storage facilities, which would generally be expected to involve larger quantities than would ever be involved in a small aircraft accident, EPA guidelines provide for "natural attenuation" or volatilization and biodegradation to mitigate environmental hazards (EPA 2000). Thus, even where oil spills in small aircraft accidents are not cleaned up, the oil does not persist in the environment or persists in such small quantities that no significant hazard exists. Also, WS's accidents generally would occur in remote areas away from human habitation and drinking water supplies. Thus, the risk to drinking water appears to be exceedingly low or nonexistent.

3.4.1.3 Lead Contamination from the Use of Lead Ammunition

Questions have arisen about the deposition of lead into the environment from ammunition used in firearms to remove wildlife causing damage (*e.g.*, predators killing livestock). As described in Section 3.1, the lethal removal of coyotes, bears, red fox, mountain lions or other predatory wildlife with firearms by WS-Colorado to alleviate damage or threats would occur using a handgun, rifle, or shotgun.

APHIS-WS is conducting a risk analysis on the use of lead in wildlife damage management. This analysis has not been finalized, but when it is, WS-Colorado will consider any analyses or recommendations not considered in this EA. If additional analyses in the risk analysis warrant further analysis for the use of lead in PDM by WS-Colorado, this EA will be updated as necessary. If additional recommendations are provided in the risk analysis which would increase safety and be appropriate to WS-Colorado's PDM program, WS-Colorado will implement those recommendations, as appropriate.

The take of coyotes by WS-Colorado using firearms would occur primarily from the use of shotguns. However, the use of rifles would be employed in some situations (*e.g.*, calling and shooting, decoy dogs, and shooting). Other wildlife depredating livestock would likely be taken with rifles. To reduce risks to human safety and property damage from bullets passing through coyotes and other predatory animals, the use of shotguns and rifles would be applied in such a way (*e.g.*, caliber, bullet weight, distance) to minimize bullets passing through target animals.

However, deposition of lead into soil would occur if, during the use of a shotgun or rifle, the projectile passes through a target animal, if misses occur, or if the target animal carcass was not retrieved. Laidlaw *et al.* (2005) reported that, because of the low mobility of lead in soil, all of the lead that accumulates on the surface layer of the soil is generally retained within the top 20 cm (about 8 inches).

Another concern is that lead from bullets deposited in soil from shooting activities would contaminate ground water or surface water from runoff. Stansley *et al.* (1992) studied lead levels in water that was subjected directly to high concentrations of lead shot accumulation because of intensive target shooting at several shooting ranges. Lead did not appear to "*transport*" readily in surface water when soils were neutral or slightly alkaline (*i.e.*, not acidic), but lead did transport more readily under slightly acidic conditions. Although Stansley *et al.* (1992) detected elevated lead levels in water in a stream and a marsh that were in the shot "*fall zones*" at a shooting range, the study did not find higher lead levels in a lake into which the stream drained, except for one sample collected near a parking lot. The authors believed the lead contamination near the parking lot was due to runoff from the lot, and not from the shooting range areas. The study also indicated that even when lead shot was highly accumulated in areas with permanent water bodies present, the lead did not necessarily cause elevated lead levels in water further downstream. Muscle samples from two species of fish collected in water bodies with high lead shot accumulations had lead levels that were well below the accepted threshold standard of safety for human consumption (Stansley *et al.* 1992).

Craig *et al.* (1999) reported that lead levels in water draining away from a shooting range with high accumulations of lead bullets in the soil around the impact areas were far below the "*action level*" of 15 parts per billion as defined by the EPA (*i.e.*, requiring action to treat the water to remove lead). The study found that the dissolution (*i.e.*, capability of dissolving in water) of lead declines when lead oxides form on the surface areas of the spent bullets and fragments (Craig *et al.* 1999). Therefore, the transport of lead from bullets or shot distributed across the landscape was reduced once the bullets and shot formed crusty lead oxide deposits on their surfaces, which served to naturally reduce the potential for ground or surface water contamination (Craig *et al.* 1999). These studies suggest that, given the very low amount of lead being deposited and the concentrations that would occur from WS-Colorado's PDM activities, in addition to most other forms of dry land small game hunting in general, lead contamination of water from such sources would be minimal to nonexistent.

3.4.1.4 Potential Impacts on Public Safety and Pet Safety from the Use of M-44s.

M-44s are used very infrequently by WS-Colorado. During FY12-16, WS-Colorado took an average of 26 coyotes and 1 red fox per year with M-44s, which is approximately 1.3% of total annual coyote take, and 1.2% of red foxes. The use of M-44s by WS-Colorado is also very low compared to nationwide use. The 27 predators taken on average by WS-Colorado during FY12-16 represents 0.2% of the animals taken nationally with M-44s (14,321 animals taken nationally by APHIS-WS; WS 2017i). There have been no exposures to people or pets due to WS-Colorado's use of M-44s during FY12-16. In fact, there have been no exposures to humans or pets during the past 19 years in Colorado. Under Alternative 1, we anticipate similar, or slightly higher use of M-44s, up to 50 per year. WS-Colorado does not use M-44s on public lands, which should also limit the likelihood of any human or pet exposure. We do not anticipate any significant impact on human or pet safety due to the use of M-44s under Alternative 1.

3.4.1.5 Potential Impacts on Public Safety from Mountain Lions Attacking People.

Mountain lions are symbol of wilderness and majesty for some people concerned with the lion's well-being. While mountain lions rarely attack people, the cause of the attacks are sometimes related to disease, malnutrition of the lion or are thought to occur because the human's passive behavior simulated prey. Some mountain lion advocates have postulated that lion attacks increase due to hunting and/or take or lions during PDM. However, we have seen no data to support this supposition. In fact, data show that attacks on humans are unrelated to whether legal mountain lion hunting seasons occur within a state (Beier 1991). In California, where hunting of mountain lions has been banned since 1972, there are still attacks on people. Some attacks are fatal. From 1986 to 2014, there were 14 attacks on people in California, 3 attacks were fatal (CDFW 2017b). The number of incidents involving people and mountain lions in California ranged from 127 to 214 from 2009 to 2013 (CDFW 2017b).

Beier (1991) documented an increase in mountain lion attacks on people in the western United States, especially during the 1970's and 1980s'. These increases in attacks on people were concurrent with increases with attacks on livestock in California by mountain lions (Fitzhugh and Gorenzel 1986). During this time period of increasing attacks on people there was no mountain lion hunting season in California.

There are many factors involved in understanding mountain lion attacks on people (Mattson *et al.* 2011). Models were developed to explain variation in odds lions would attack and injure or kill a human. Cougars that are young (<2.5 years) or unhealthy are more likely to be involved in close encounters with humans. In close encounters, female mountain lions are more likely to attack humans than male mountain lions. When a mountain lion attacks a human, adult lions are more likely to kill the human (32% versus 9% of attacks). Killing the close encounter mountain lion, which happened 82% of the time, or yelling, throwing objects and increasing stature substantially lessened odds of attack. People who moved quickly or erratically were more likely to be attacked or killed. The lowest likelihood of avoiding injury with mountain lions was to remain stationary (Coss *et al.* 2009). Children are more likely than single adult humans to be attacked. Coss *et al.* (2009) determined that mountain lions were assessing immobility in humans as mountain lion assess other prey. This assessment suggests that mountain lions are assessing prey inattention or disablement and hence greater vulnerability. Overall attacks by mountain lions (4-6 per year in the U.S. and Canada) compared to African or Asian lions, tigers and other big cats or wolves (hundreds to thousands per year) (Mattson *et al.* 2011).

Whether WS-Colorado captures and/or kills mountain lions to protect livestock, pets, people, or other resources will not influence mountain lion attacks on people. Mountain lions attacks on people do occur in Colorado, and on rare occasions have resulted in human fatalities. Some of the most recent incidents have occurred in urban/suburban environments where hunting does not take place.

3.4.1.6 Potential Impacts on Public Safety from Black Bears Attacking People.

The removal of aggressive or bold black bears under Alternative 1, some of which are repeat offenders, improves human safety, because these are the bears which are likely to threaten people, attack people, or break into homes and cars. This work would be conducted under black bear management policies developed by CPW.

3.4.1.7 Potential Impacts on Public Safety due to Zoonotic Diseases

Some commenters have suggested that the removal of predators would result in increased transmission of zoonotic diseases among wildlife, which would increase the risk of these diseases to humans. As analyzed in Section 3.1.1, cumulative take of target predator species would not significantly impact the populations of these predators. As such, and as analyzed in Sections 3.2.1 and 3.3.1, non-target animal populations and ecosystem function would not be significantly impacted under Alternative 1. We also assessed the potential for predator removal to result in increased transmission of diseases of wildlife, and found that there is no evidence that this would occur under Alternative 1, including zoonotic diseases such as brucellosis (Section 3.3.1.3). These findings show that the potential for any increase in transmission of zoonotic diseases among wildlife would be insignificant under Alternative 1.

3.4.1.8 Potential Impacts on Pets and Pet Safety

APHIS-WS and WS-Colorado incorporate numerous protective measures (Section 2.11) to minimize the likelihood of impact to pets and pet safety. During FY12-16, WS-Colorado unintentionally captured one domestic dog, which was released alive and unharmed. We do not consider the nonlethal capture of a single, unharmed dog over the course of five years to be a significant impact to the environment. Still, APHIS-WS and WS-Colorado strive to minimize such take whenever feasible.

Under Alternative 1, WS-Colorado would remove coyotes and mountain lions from areas where they might otherwise attack or kill additional pets. In addition, when coyotes are killing or attempting to kill pets in urban/suburban areas, this is an indication of a bold or aggressive coyote, which is likely to attack people (Baker and Timm 2017). These actions would be likely to save additional pets, in addition to protection public safety.

WS-Colorado uses hounds to capture depredating mountain lions and black bears, as discussed in Section 3.6.1. The risk of injury or death to the hounds, though not actually pets, is discussed here because they are dogs, which are typically considered pet animals by most people. As discussed in Section 3.6.1, WS-Colorado incorporates numerous measures to minimize the likelihood of injury or death to either the hounds or the target predators. These measures have been extremely successful; altercations with predators or other wildlife is extremely rare, as discussed in Section 3.6.1. Under Alternative 1, we do not anticipate any significant risk to the hounds.

3.4.1.9 Potential for Hazards to Human Health and Safety Due to the Use of Livestock Protection Dogs on Public Lands

Dogs have been used as a non-lethal method to protect livestock from predators for centuries (see Appendix A). Livestock protection dogs are used by many producers in Colorado, and might be recommended by WS-Colorado. Livestock protection dogs are generally large and aggressive breeds, such as Great Pyrenees, and these dogs might present a danger to humans and pets who enter or approach the protected flock. As such, WS-Colorado recommends the posting of warning signs, and limiting access as much as possible. On private lands, such problems are rare, because legal access can be controlled. On public lands, livestock grazing areas are generally separate from high use recreation areas, which limits interactions. However, on public lands, there have been a few instances of guard dogs biting recreationists who ignored guard dog warning signs, and rode bicycles into flocks of sheep, triggering protective responses from guard dogs. Such incidents have prompted APHIS-WS, USFS, and sheep producers to develop an educational program, and to post notices at trailheads and along trails informing outdoor recreationists that guard dogs may be with sheep, and to keep their distance. Also, USFS requires event organizers to avoid inserting participants into sheep herds which may be protected by guard dogs. These efforts have reduced conflicts between guard dogs and outdoor recreationists. Such human and pet interactions with livestock protection dogs are rare, but might occur under Alternative 1, or any Alternative in which livestock graze on public lands, and livestock protection dogs are used, including Alternatives 2, 3, and 4.

3.4.1.10 Summary of Direct, Indirect, and Cumulative Impacts on Human and Pet Health and Safety

The use of PDM methods by WS-Colorado pose little potential direct hazard to WS-Colorado employees themselves or to the public, because all methods and materials are consistently used in a manner known to be safe. Many protective measures are in place to mitigate impacts to public safety and pets. We analyzed numerous other public safety concerns, and found no evidence to support them. Many protective measures have been implemented within the last 2 decades to reduce the risk of PDM conducted by WS-Colorado to negatively impact pets. Under Alternative 1, we anticipate negligible risk to pets.

Potential indirect impacts, including the deposition of lead in the environment, are anticipated to be negligible. However, WS-Colorado must be vigilant in maintaining safe procedures and protective measures; otherwise, some of the public safety concerns may become real.

WS is a leader in the field of WDM, and we serve as a role model for how to conduct PDM in a manner that is safe for people and pets. We demonstrate, teach, and publish articles on how to conduct PDM. The cumulative impact of this information transfer should result in lower impacts to human safety and pets.

3.4.2 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

Direct, Indirect, and Cumulative Impacts: Under Alternative 2, WS-Colorado would not conduct preventive operational PDM. As discussed previously (Section 3.1.1), some of this work would likely be conducted instead by CDA, CPW, and private individuals/entities. Preventive PDM by WS-Colorado is currently only conducted on areas of historic loss of livestock to coyotes, where such losses are expected to reoccur. Much of this work is conducted with aerial PDM. Under Alternative 2, PDM, including some aerial PDM, would likely be implemented in these historic loss areas by individuals with less experience than WS-Colorado personnel, resulting in higher risks to public safety. Some livestock producers might become frustrated over the inability of WS-Colorado to prevent losses, and might resort to the use of more dangerous or even illegal methods. The increased use of less selective methods by less experienced persons would increase the likelihood of non-target capture, including the capture of pets. This may result in increased injury to or loss of pets due to PDM. However, many private citizens would involve WS-Colorado after damage had occurred. Therefore, the use of dangerous and illegal methods would likely be low. Risks from illegal chemical toxicant use under this alternative would probably be slightly higher than the proposed action (Alternative 1). Under Alternative 2, risks to public safety and pets would be lower than Alternatives 3 and 4. These differences would not likely reach the level of any significant impacts. Under Alternative 2, there would be no significant impacts on human and pet health and safety.

3.4.3 Alternative 3 - WS-Colorado Provides Technical Assistance Only.

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS-Colorado would provide advice or guidance on PDM techniques and methods, but would not conduct any direct operational PDM in attempting to assist in resolving damage complaints. Therefore, WS-Colorado would not have any direct impact on public safety or pets in Colorado. The risks to human and pet health and safety under this Alternative would be higher than those under Alternative 2, and moderately higher than Alternative 1, because more PDM would be conducted by less experienced entities, using less selective methods, with less oversight and training. The injury and loss of pets would also likely be higher, due to increased non-target capture.

In addition, WS-Colorado would not be able to respond to predator complaints involving human health and safety. Depending on their level of effort, CPW may be able to respond in a timely manner. Human health and safety problems associated with predators could increase slightly, but some damage problems could either go unresolved or be handled by private individuals with similar risks described above. Unresolved threats to human health and safety would result in a negative impact on human safety under Alternative 4.

CDA or CPW could still issue aerial PDM permits to the public. The number of these permits, and the amount of flying conducted under these permits would likely increase because producers know that this method is effective. Low-level flying has inherent risks associated with it. The number of accidents during aerial PDM would likely increase because private pilots would most likely have less experience and less training than WS pilots, and would not likely work under a robust aviation safety program such as that of APHIS-WS and WS-Colorado.

Because of the moderately increased risk of injury or loss of pets from non-target capture, the increased risk from the use of more dangerous methods by less experienced entities, the increased risk from coyotes and mountain lions attacking people and pets, and the increased risk of accidents during aerial PDM, the cumulative impact to human and pet health and safety under Alternative 3 would likely be significant. Under Alternative 3, there would be likely be significant negative impacts on human and pet health and safety.

3.4.4 Alternative 4 – No PDM by WS-Colorado.

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Colorado would not provide assistance with PDM; therefore, there would be no direct impact by WS PDM on public safety, pets, or "environmental justice and executive order 12898." CDA and CPW would probably still provide some level of PDM, and private efforts to reduce damage would likely increase, similar to that under Alternative 3. Compared to the current program alternative (Alternative 1), Alternative 4 would likely result in increased risks to human and pet safety, as discussed for Alternative 3 (Section 3.4.3).

Because of the moderately increased risk of injury or loss of pets from non-target capture, the increased risk from the use of more dangerous methods by less experience entities, the increased risk from coyotes and mountain lions attacking people and pets, and the increased risk of accidents during aerial PDM, the cumulative impact to human and pet health and safety under Alternative 3 would likely be significant. Under Alternative 4, there would be likely be significant negative impacts on human and pet health and safety.

3.5 Issue E: Effects of WS-Colorado PDM on Use of Public Lands

Most recreationist concerns regarding PDM center around perceived impacts on hunting, photography, wildlife viewing, and enjoyment of seclusion. The issue was described, and WS-Colorado's protective measures were addressed in Chapter 2. WS-Colorado conducts PDM mainly on two classes of public lands in Colorado: BLM and USFS. The potential impacts of PDM on these lands are discussed below, including the potential impact of PDM of Special Management Areas (SMAs), including Wilderness Areas (WAs) and Wilderness Study Areas (WSAs). PDM is conducted mostly for the protection of livestock on grazing allotments in these areas. These areas are typically removed from high public-use areas.

3.5.1 Alternative 1 - Continue the Current Federal PDM Program

WS-Colorado conducts PDM and other wildlife damage management (WDM) on several classes of public lands. This analysis utilizes data from the APHIS-WS Management Information System (MIS), where all work is recorded. MIS categorizes work into agreements. These agreements may consist of private land, public land, or both. In many cases, an agreement on BLM or USFS lands covers a grazing allotment, which is comprised entirely of federal land. In some cases, however, an agreement may cover a grazing allotment as well as abutting private lands. As such, our data analysis includes some degree of work conducted on private lands, because it is difficult to parse these data out. For example, our MIS reports for BLM lands show the take of coyotes by M-44s. WS-Colorado does not use M-44s on public lands, so this is clearly in error. This take was conducted on abutting private lands within agreements linked to BLM lands. This M-44 take is easy to spot, and it has been removed from our analysis; however, other take, visits, hours, and acreage worked has not been removed due to the difficulty involved. As such, the analyses below slightly overestimate our potential for impact on public lands. Moreover, PDM is not the only work conducted on public lands. Our data also include some visits, hours, acreage, and allotments worked for other types of WDM, such as managing beaver damage. The take of beavers has been omitted from this analysis, but the visits, hours, and acreage and allotments worked for beaver damage has not been removed due to the difficulty involved. This too will cause our analyses to slightly overestimate our potential impact on public lands. The majority of WS-Colorado PDM on public lands is conducted on Bureau of Land Management (BLM) and U.S. Forest Service (USFS) lands, so our analysis will focus on these land classes.

3.5.1.1 WS-Colorado PDM on BLM Lands.

WS-Colorado conducted PDM on 46 (2.0%) of the 2,339 BLM grazing allotments in Colorado during FY12-16. These allotments covered an average of 676,270 (6.3%) of the 10.8 million acres of BLM lands in Colorado[5] (Table 3-16). As previously discussed, WS-Colorado actually conducts PDM on only about 1/5 of the total lands under agreement each year (WS 1997; see Section 3.1.1). As such, the actual BLM acreage with PDM is estimated at 1.3% of BLM lands. More than 98% of the area of BLM lands, and 98% of BLM grazing allotments are not subject to WS-Colorado PDM in any typical year. WS-Colorado spent an average of 1,055 hours annually in the conduct of PDM on BLM lands during this timeframe. There are 8,760 hours in a year, perhaps half of which are during daylight. Assuming that most recreational use of public lands occurs during daylight hours, less than 25% of this time (4,380 hours) was exposed to WS-Colorado PDM over the entirety of BLM lands in Colorado. In other words, if recreationists were to simultaneously occupy all 10.8 million acres of BLM lands in Colorado, they would still only have a 25% chance of seeing a WS-Colorado employee working. And much of this work is conducted during the winter and early spring, when recreational use is more limited.

Another way to assess potential impacts is to analyze the frequency of visitations, or the number of days that WS-Colorado personnel visited BLM lands. Each time a WS-Colorado employee works on BLM lands, it is counted as a "person-day-visit", regardless of how long the work was performed. During FY12-16, WS-Colorado PDM averaged 274 person-day visits per year. The average time spent on BLM property per visit was 3½-4 hours. The vast majority of PDM is also conducted on grazing allotments, which are not commonly used for recreation. PDM conducted outside of grazing allotments is generally for alleviating threats to human safety.

Average WS-Colorado PDM take on BLM lands during FY12-16 was 208 coyotes, 7 red foxes, and 4 black bears per year. There was also 1 mountain lion taken on BLM land during this 5-year timeframe. BLM manages 10.8 million acres in Colorado, which is about 16% of the land area in Colorado. Compared to the statewide averages (Table 14), the take on BLM lands was only 11% of total take for coyotes, 8% for red fox, and 6% for black bear. Most WS-Colorado PDM, and most predator take, occurs on private lands. These numbers reflect that trend; predator take on BLM lands (maximum of 11% of total take) was much lower than the

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[5] BLM grazing allotments estimated at 10,818,387 acres based on data from BLM Colorado State Office. BLM surface acres in Colorado is 8,331,848. Some acreage in Utah, and some non-BLM land that is intermingled with BLM-administered land is included in both the former number and the individual allotment acreages used to calculate the number of acres flown by WS. We were unable to separate out these types of acreage, so the former number was used to calculate the percentage.

proportion of land in Colorado managed by BLM (16%). Because most WS-Colorado PDM (75% of hours worked) on BLM lands was conducted on the Little Snake, Uncompahgre Basin, and White River Resource Areas (RAs), further analysis focuses on these three RAs (Table 3-16).

In the Little Snake RA, WS-Colorado spent an average of 304 hours over 110 person-day-visits per year conducting PDM. This work was conducted on agreements which covered 338,556 acres of BLM lands, which is 26% of the acreage of the RA. As discussed earlier, WS-Colorado actually conducts PDM on only about 1/5 of the land under agreement for PDM work, so we estimate that WS-Colorado conducted PDM on about 5.2% of the lands in this RA. This RA has the highest potential for impact because more PDM was conducted here than on any other RA. However, even on this RA, more than 94% of the lands were not subject to PDM. Furthermore, the higher level of PDM on this RA reflects the higher numbers of sheep grazed on these lands. And whereas sheep grazing is not inconsistent with recreation, sheep grazing habitat is not popular for many recreational activities, such as hiking, camping, mountain biking, fishing, sight-seeing, horseback riding, off-road-vehicle use, and most hunting. There are 364 grazing allotments in the Little Snake RA, and WS-Colorado conducted PDM on 16 (4.3%) of them. Average WS-Colorado predator take in this RA was 131 coyotes and 2 black bear per year (Table 3-16).

Table 3-16. Summary of Wildlife Services-Colorado wildlife damage management (WDM) activities on Bureau of Land Management (BLM) lands in Colorado during Federal fiscal years 2012-2016. Numbers are the annual averages of these five years. Most, but not all, work was conducted for predator damage management.[a]

BLM Resource Area (RA)	WDM Hours	Person-Day Visits	Total Acres	Acres Under Agreement	Acres with WDM[b]	Grazing Allot.	Allot. with WDM	Coyote Take	Red Fox Take	Black Bear Take
Little Snake	304	110	1,300,000	338,556 (26%)	67,711 (5.2%)	364	16 (4.3%)	131	0	2
Uncompahgre Basin	221	71	483,077	91,668 (19%)	18,334 (3.8%)	157	13 (8.3%)	42	3	0
White River	271	51	1,455,900	42,663 (2.9%)	8,533 (0.6%)	153	7 (4.6%)	10	0	2
All Other Colorado RAs	259	42	7,579,410	203,383 (2.7%)	40,677 (0.5%)	1,665	10 (0.6%)	25	4	0
All BLM Lands	1,055	274	10,818,387	676,270 (6.3%)	135,254 (1.3%)	2,339	46 (2.0%)	208	7	4

Allot., BLM allotment; RA, WDM, wildlife damage management; RA, BLM Resource Area.
[a] Data is analyzed by agreement, and work includes mostly predator damage management, but also other WDM work. Some agreements contain both BLM land and private land; some acres, hours, visits, and take occurred on private lands.

[b] Acres with WDM is based on WS (1997a), who reported that ~1/5 of lands under agreement are worked in any year.

In the Uncompahgre Basin RA, WS-Colorado spent an average of 221 hours over 71 person-day-visits per year conducting PDM. This work was conducted on agreements which covered 91,668 acres of BLM lands, which is 19% of the acreage of the RA. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement, the actual proportion of these lands with PDM is estimated at 3.8%. There are 157 grazing allotments in the Uncompahgre Basin RA, and WS-Colorado conducted PDM on 13 (8.3%) of them. Average WS-Colorado predator take in this RA was 42 coyotes and 3 red fox per year (Table 3-16).

In the White River RA, WS-Colorado spent an average of 271 hours over 51 person-day-visits per year conducting PDM. This work was conducted on agreements which covered 42,663 acres of BLM lands, which is 2.9% of the acreage of the RA. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement, the actual proportion of these lands with PDM is estimated at 0.6%. There are 153 grazing allotments in the White River RA, and WS-Colorado conducted PDM on 7 (4.6%) of them. Average WS-Colorado predator take in this RA was 10 coyotes and 2 black bear per year (Table 3-16).

In all other Colorado RAs combined, WS-Colorado spent an average of 259 hours over 42 person-day-visits per year conducting PDM. This work was conducted on agreements which covered 203,383 acres of BLM lands, which is 2.7% of the acreage of these RAs. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement, the actual proportion of these lands with PDM is estimated at 0.5%. There are 1,826 grazing allotments in these RAs, and WS-Colorado conducted PDM on 10 (0.6%) of them. Average WS-Colorado predator take in these RAs was 25 coyotes and 4 red fox per year (Table 3-16).

Aerial PDM on BLM Lands: WS-Colorado conducted aerial PDM on an average of only 25 (range 20-28), or 1% of the 2,339 BLM grazing allotments in the State each year during FY12-16. The land area of BLM grazing allotments exposed to WS-Colorado aerial PDM averaged 431,305 acres (range 372,314-492,677) annually during FY12-16, which is 4.0% of the total BLM lands in Colorado. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement, the actual proportion of these lands with aerial PDM is estimated at less than 1%. Therefore, in terms of acreage, more than 99% of the BLM lands were not exposed to any WS-Colorado aerial PDM operations in any one year. Over the entire five-year period of FY12-16, WS-Colorado flew 45 different BLM allotments (but never more than 28 in any one year), 32 (71%) of which saw less than 3 WS-Colorado flights per year on average (Table 3-17). Twelve of the remaining 13 allotments (27%) saw between 3 and 9 flights per year on average. The Fortification Allotment in the Little Snake RA saw the most flights per year: an average of 13.6. In any given year, some allotments were flown more frequently, but no allotment was flown on more than 19 days in any one year. Thus, even on the most frequently flown allotments, WS-Colorado aerial PDM occurred on only 5% of the days of the year. Moreover, the average flight time on any BLM allotment was 0.8 hours on any given day; thus, the amount of time spent flying over any BLM allotment was considerably less than 5%. The average flying time per Allotment was 1.7 hours per year, which is less than 0.04% of the daytime hours in a year. The maximum flying time over any Allotment was 21.8 hours on the Sand Wash Allotment in FY12. Even this corresponds to less than 0.5% of the daylight hours in that year (Table 3-17, Appendix B).

And as noted above, potential conflicts with recreational use are even lower than these numbers would suggest, because most of this work was conducted in winter and early spring, when recreational use is more limited; and all of this work was conducted on grazing allotments, where recreational use is also more limited.

Because the most intensive WS-Colorado aerial PDM during FY12-16 occurred in the Little Snake, Uncompahgre RAs, and to a lesser extent, the White River RA, we focus further analysis on those areas.

In the Little Snake RA, there are 364 grazing allotments managed by BLM. WS-Colorado conducted aerial PDM on an average of 12 (range 10-15), or 3% of these allotments per year. Therefore, about 97% of the allotments in the Little Snake RA were not exposed to any aerial PDM by WS-Colorado in a typical year. On a land area basis, the acreage of allotments flown per year ranged from about 275,000 to 350,000 (average 314,881), which is approximately 15% of the total acreage of grazing allotments in the Little Snake RA. And because only about 1/5 of the total acreages on WS-Colorado aerial PDM agreements are actually flown, we estimate that only about 3% of BLM lands in the Little Snake RA were actually flown by WS-Colorado in any typical year. Therefore, 97% of the land area of this RA is not exposed to any aerial PDM in a typical year (Table 3-17, Appendix B).

Twenty-one allotments in the Little Snake RA were exposed to aerial PDM by WS-Colorado at some point within the five-year timeframe FY12-16. Of those, 13 (62%) were exposed to less than 3 flights per year on average. Seven of the remaining 8 allotments (33%) saw an average of less than 9 flights per year. The exception was Fortification, which saw an average of 13.6 flights per year, with a maximum of 19 flights in any year. No allotment was flown more than 19 times in any one year (Table 3-17, Appendix B).

In the Uncompahgre Basin RA, there are 157 grazing allotments managed by BLM. WS-Colorado conducted aerial PDM on an average of 8 (range 7-10), or 5% of these allotments per year. Therefore, about 95% of the allotments in the Uncompahgre Basin RA were not exposed to any aerial PDM by WS-Colorado in a typical year. On a land area basis, the acreage of allotments flown per year ranged from about 31,000 to 80,000, which is approximately 6.4% to 16.6% of the total acreage of the Uncompahgre Basin RA (483,077 acres). Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement, the maximum proportion of these lands with PDM is estimated at 3.3%. Therefore, more than 96% of the land area of this RA is not exposed to any aerial PDM in a typical year (Table 3-17, Appendix B).

Twelve allotments in the Uncompahgre Basin RA were exposed to aerial PDM by WS-Colorado at some point within the five-year timeframe FY12-16. Of those, 8 (67%) were exposed to less than 3 flights per year on average. The remaining 4 allotments (33%) saw averages of less than 8 flights per year. Although some allotments were flown more times within any given year, no allotment was flown more than 9 times in any one year (Table 3-17, Appendix B).

On the White River RA, there are 153 grazing allotments managed by BLM. WS-Colorado conducted aerial PDM on an average of 3 (range 2-3), or less than 2% of these allotments per year. Thus, more than 98% of the allotments in the White River RA were not exposed to any WS-Colorado aerial PDM in a typical year. On a land area basis, the average acreage of allotments flown per year was 36,517 (range approximately 26,000 to 47,000) which is less than 2% of the total acreage of grazing allotments in the White River RA. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement (WS 1997), the actual proportion of these lands with PDM is estimated at less than 0.5%. Therefore, more than 99.5% of the land area of this RA is not exposed to any aerial PDM in a typical year (Table 3-17, Appendix B).

Five allotments in the White River RA were flown by WS-Colorado within the five-year period FY12-16. Of these, 4 (80%) were exposed to less than 3 flights per year on average. The other allotment was exposed to 4 days of aerial PDM per year on average. Whereas some allotments saw more flights in any given year, no allotment was flown more than 7 times in any year (Table 3-17, Appendix B).

These data show that both the amount of time spent flying over BLM allotments, and the percentage of land actually flown each year are extremely low. We conclude that the impacts to BLM lands from aerial PDM are not significant.

Table 3-17. Average WS-Colorado aerial predator management hours and days flown on Bureau of Land Management (BLM) allotments and Resource Areas in Colorado during federal fiscal year 2012-2014.

BLM Resource Area (RA)	Allotment Name	Acres	Average Hours	Average Days Flown
Glenwood	Bocco Mtn.	4,040	**0.2**	**0.2**
	State Bridge	5,699	**0.4**	**0.4**
Subtotal Glenwood		**9,739**	**0.6**	**0.6**
Grand Junction	Badger Wash	60,000	**0.8**	**0.6**
	East Salt Ck.	30,000	**0.6**	**0.6**
	Prairie Canyon	58,000	**0.4**	**0.6**
Subtotal Grand Junction		**148,000**	**1.7**	**1.8**
Gunnison	Sapinero Mesa	**5,160**	**1.2**	**0.6**
Little Snake	Buck Mtn.	923	**0.1**	**0.2**
	Cedar Spgs.	19,319	**0.4**	**0.6**
	Crooked Wash	7,889	**0.8**	**1.0**
	Duffy Mtn.	8,545	**1.6**	**2.6**
	Fortification	4,413	**7.6**	**13.6**
	Greasewood	19,858	**4.2**	**5.2**
	Hdq Moffat	3,077	**0.9**	**1.0**
	Lay Peak	855	**0.1**	**0.2**
	Mud Spg. Gulch	978	**0.3**	**0.2**
	Nipple Peak	4,449	**3.9**	**4.2**
	Nipple Rim	39,677	**2.3**	**1.8**
	Pole Gulch	16,317	**2.7**	**3.4**
	Powder Wash	29,967	**4.1**	**3.2**
	Sand Creek	8,728	**0.1**	**0.2**
	Red Wash	15,758	**0.8**	**1.0**
	Sand Wash	64,809	**8.3**	**6.0**
	Sheepherder Spg.	84,491	**4.8**	**3.6**
	Shell Creek	7,880	**0.4**	**0.8**
	Snake River	51,710	**7.5**	**8.8**
	State Line	6,373	**0.1**	**0.2**
	West Spring Ck.	7,308	**0.2**	**0.4**
Subtotal Little Snake		**403,324**	**50.9**	**58.2**
San Juan	Yellow Jacket	**5,727**	**0.1**	**0.2**
Uncompahgre Basin	Alkali Flats	35,439	**0.2**	**0.4**
	Canal	10,482	**1.4**	**1.8**
	Cushman	6,386	**0.1**	**0.4**
	Deer Basin	11,360	**0.1**	**0.2**
	Lower Escalante	2,240	**1.0**	**1.6**
	Pipeline	10,354	**0.0**	**0.2**
	Sandy Wash	7,224	**1.1**	**1.8**
	Shavano	2,016	**0.0**	**0.2**
	Smith Mtn.	3,477	**1.6**	**5.2**
	South of Town	3,391	**2.8**	**6.8**
	Sulphur Gulch	468	**1.8**	**6.2**
	U. Peach Valley	3,727	**3.3**	**7.2**
Subtotal Uncompahgre Basin		**96,564**	**13.5**	**32.0**
White River	Banta Flats	17,871	**3.6**	**2.2**
	Boise Ck.	8,247	**5.4**	**4.0**
	Horse Draw	14,717	**0.8**	**0.6**
	Johns.-Trujillo	20,930	**0.2**	**0.2**
	Winter Valley	1,630	**0.1**	**0.2**
Subtotal White River		**63,395**	**10.1**	**7.2**
All BLM Lands		**731,909**	**78.1**	**101**

"-", no flights during that timeframe.

3.5.1.2 WS-Colorado PDM on USFS Lands.

WS-Colorado conducted PDM on an average of 52 (2.4%) of the 2,155 USFS grazing allotments per year in Colorado during FY12-16. These allotments covered an average of 399,648 (3.7%) of the 10.9 million acres of USFS lands in Colorado (Table 3-18). As previously discussed, WS-Colorado actually conducts PDM on only about 1/5 of the total lands under agreement each year (WS 1997; see Section 3.1.1). As such, the actual USFS acreage with PDM is estimated at 0.7% of USFS lands. These numbers demonstrate that WS-Colorado conducts PDM on a very small percentage of USFS lands, and that more than 99% of the area of USFS lands, and more than 96% of USFS grazing allotments are not subject to WS-Colorado PDM in any typical year. WS-Colorado spent an average of 1,764 hours annually in the conduct of PDM on USFS lands during this timeframe. Much of this PDM was conducted during the winter and early spring, when recreational use is more limited due to weather and poor accessibility (*i.e.*, snowy or muddy roads). WS-Colorado PDM averaged 317 person-day visits per year during FY12-16. One person from WS-Colorado visiting USFS land for PDM work on one day is defined as a person-day visit. This does not imply a full day of work, but rather, and indication that WS-Colorado personnel visited USFS lands on a particular day. The average time spent on USFS property per visit was 5-6 hours (Table 3-18). The vast majority of PDM is also conducted on grazing allotments, which are not commonly used for recreation. PDM conducted outside of grazing allotments is generally for alleviating threats to human safety.

Table 3-18. Summary of WS-Colorado Predator damage management (PDM) activities on United States Forest Service (USFS) lands in Colorado during federal fiscal years 2012-2016. Numbers are the annual averages of these five years. Most, but not all, work was conducted for PDM.[a]

	PDM Hours	Person-Day Visits	Total Acres	Acres under Agreement	Acres with PDM [b]	Grazing Allot.	Allot. with PDM	Coyote Take	Red Fox Take	Black Bear Take
Routt NF	947	178	935,782	114,242 (12%)	22,848 (2.4%)	139	25 (18%)	80	1	13
White River NF	266	48	1,462,365	75,583 (5.2%)	15,117 (1.0%)	135	9 (6.7%)	13	0	3
GMUG NF	236	36	3,161,900	70,618 (2.2%)	14,124 (0.4%)	159	7 (4.4%)	15	0	6
All Other NF/NGs	315	55	5,339,953	139,204 (2.6%)	27,841 (0.5%)	1,722	11 (0.6%)	24	3	3
All USFS Lands	1,764	317	10,900,000	399,648 (3.7%)	79,930 (0.7%)	2,155	52 (2.4%)	132	4	25

[a] Data is analyzed by agreement, and work includes mostly PDM, but also some other wildlife damage management work. Some agreements contain both USFS land and private land; all acres, hours, visits, and most take is included, some of which occurred on private lands.

[b] Acres with PDM is based on WS (1997), who reported that ~1/5 of lands under agreement are worked in any year.

"Allot.", Allotment; "NF", National Forest; "GMUG NF", Grand Mesa, Uncompahgre, and Gunnison National Forests; "NG", National Grassland

Average WS-Colorado PDM take on USFS lands during FY12-16 was 132 coyotes, 4 red fox, and 25 black bears per year. There was also 1 mountain lion taken on USFS land during this 5-year timeframe. USFS manages 10.9 million acres in Colorado, which is about 16% of the land area in Colorado. Compared to the statewide averages (Table 3-1), the take on USFS lands was only

7% of total predator take: 7% for coyotes and 4% for red fox. As discussed earlier, most WS-Colorado PDM, and most predator take, occurs on private lands. These numbers reflect that trend; predator take on BLM lands (7% of total predator take) was much lower than the proportion of land in Colorado managed by USFS (16%). Black bear take on USFS lands represented a higher proportion of the statewide take of this species (35%) than would be expected based on land area (16%). This is likely due to differences in habitat types. Black bears prefer heavily forested habitats, and USFS manages 47% of Colorado's forests (Colorado State Forest Service 2016). BLM manages only 17% of Colorado's forests (Colorado State Forest Service 2016); much of the BLM land in Colorado is prairie. Private lands comprise 30% of Colorado's forests (Colorado State Forest Service 2016), and have more prairie/pasture land (Table 3-18).

Because most (81%) of our PDM on USFS lands was conducted on the Routt, White River, and GMUG (Grand Mesa, Uncompahgre and Gunnison) NFs, further analysis focuses on these three NFs (Table 3-18).

On the Routt NF, WS-Colorado spent an average of 947 hours over 178 person-day visits per year conducting PDM. This work was conducted on agreements which covered 114,242 acres, which is 12% of the acreage of this NF. Because WS-Colorado actually conducts PDM on only about 1/5 of the land under agreement for PDM work (WS 1997), we estimate that WS-Colorado conducted PDM on about 2.4% of the lands in the Routt NF. This NF has the highest potential for impact because more PDM was conducted here than on any other NF in Colorado. In fact, WS-Colorado conducted more PDM on this NF than all other NFs and NGs combined (54% of PDM hours). However, even on this NF, more than 97% of the lands were not subject to PDM. Furthermore, the higher level of PDM on this NF reflects the higher numbers of sheep grazed on these lands. And whereas sheep grazing is not inconsistent with recreation, sheep grazing habitat is not popular for many recreational activities, such as hiking, camping, mountain biking, fishing, sight-seeing, horseback riding, off-road-vehicle use, and most hunting. Thus, the specific areas where WS-Colorado conducted PDM were less likely to interfere with recreation. There are 139 grazing allotments in the Routt NF, and WS-Colorado conducted PDM on 25 (18%) of them. Average WS-Colorado predator take in this NF was 80 coyotes, 1 red fox, and 13 black bears per year (Table 3-18).

On the White River NF, WS-Colorado spent an average of 266 hours over 48 person-day visits per year conducting PDM. This work was conducted on agreements which covered 75,583 acres on average, which is 5.2% of the acreage of this NF. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement (WS 1997), the actual proportion of these lands with PDM is estimated at 1%. There are 135 grazing allotments in the White River NF, and WS-Colorado conducted PDM on 9 (6.7%) of them. Average WS-Colorado predator take in this NF was 13 coyotes and 3 black bears per year (Table 3-18).

The Grand Mesa, Uncompahgre, and Gunnison (GMUG) NFs are co-managed by USFS, so they are combined for our analyses also. On the GMUG NF, WS-Colorado spent an average of 236 hours over 36 person-day visits per year conducting PDM. This work was conducted on agreements which covered 70,618 acres, which is 2.2% of the acreage of this NF. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement (WS 1997), the actual proportion of these lands with PDM is estimated at 0.4%. There are 159 grazing allotments in the GMUG NF, and WS-Colorado conducted PDM on 7 (4.4%) of them. Average WS-Colorado predator take in this NF was 15 coyotes and 6 black bears per year (Table 3-18).

On all other Colorado NFs and NGs combined, WS-Colorado spent an average of 315 hours over 55 person-day visits per year conducting PDM. This work was conducted on agreements which covered 139,204 acres, which is 2.6% of the acreage of these NFs/NGs. Because WS-Colorado conducts PDM on only about 1/5 of the land under agreement, the actual proportion of these lands with PDM is estimated at 0.5%. There are 1,722 grazing allotments in these NFs/NGs, and WS-Colorado conducted PDM on 11 (0.6%) of them. Average WS-Colorado predator take in these NFs/NGs was 24 coyotes, 3 red fox, and 3 black bears per year (Table 3-18).

<u>Aerial PDM on USFS Lands</u>: Table 3-19 shows WS-Colorado aerial PDM activity on USFS NFs and NGs in Colorado during FY12-16. WS-Colorado conducted aerial PDM on an average of 12 (range 11 to 15) USFS grazing allotments per year during FY12-FY16, which was less than 1% of the 2,155 total USFS grazing allotments in the State. Therefore, more than 99% of USFS grazing allotments are not exposed to any WS-Colorado aerial PDM in any typical year. On a land area basis, the total acreage of USFS allotments flown averaged 63,632 acres per year (range approximately 40,000 to 90,000).

Table 3-19. WS-Colorado aerial predator management time and days flown on United States Forest Service (USFS) lands in Colorado during federal fiscal year (FY) 2010-14.

	Allotment	Acres	Aerial Predator Management Hours						Days Flown					
			FY12	FY13	FY14	FY15	FY16	Avg.	FY12	FY13	FY14	FY15	FY16	Avg.
Comanche Grasslands		15,500	2.8	-	4.4	-	-	1.4	2	-	2	-	-	0.8
Routt NF Hahn's Peak Bear's Ear District	California Park	3,291	2.0	8.2	3.4	4.0	1.0	3.7	2	14	5	8	1	6.0
	E. Quaker Mtn.	4,670	0.5	3.0	1.6	0.5	1.5	1.4	1	7	3	1	3	3.0
	Fortification	3,447	-	-	-	1.0	-	0.2	-	-	-	1	-	0.2
	Hole in the Wall	2,295	0.6	0.9	1.4	-	-	0.6	1	3	2	-	-	1.2
	Johnson Creek	3,495	2.0	2.2	2.1	2.5	-	1.8	3	5	5	4	-	3.4
	Potholes	3,141	2.1	5.9	3.6	2.5	1.2	3.1	4	15	6	3	3	6.2
	Quaker Mtn.	544	-	-	-	1.0	-	0.2	-	-	-	1	-	0.2
	Sawmill Creek	2,246	-	1.1	1.5	-	0.5	0.6	-	3	3	-	1	1.4
	Sawtooth	5,038	1.0	1.0	0.5	0.3	0.5	0.7	1	3	1	1	1	1.4
	Slater-Adams	1,120	1.0	2.2	2.6	2.0	-	1.6	2	3	4	4	-	2.6
	Slide Mtn.	4,475	-	4.2	3.6	-	1.0	1.8	-	10	8	-	1	3.8
	Stewardship	13,240	6.0	5.6	2.6	3.5	1.9	3.9	7	9	4	6	2	5.6
	W. Quaker Mtn.	4,128	-	0.4	0.4	-	-	0.2	-	1	1	-	-	0.4
Subtotal Routt NF		51,130	15.2	34.7	23.3	17.3	7.6	19.6	21	73	42	29	12	35.4
White River NF Blanco District	Aldrich Lake	3,084	1.0	2.7	-	-	-	0.7	1	4	-	-	-	1.0
	Lost Park	2,615	-	2.1	-	0.5	1.6	0.8	-	3	-	1	1	1.0
	Milk Creek	7,261	2.3	3.6	2.5	-	2.4	2.2	3	5	2	-	3	2.6
	Sawmill Mtn.	4,995	1.0	2.1	2.0	-	-	1.0	1	3	2	-	-	1.2
	Three Points	3,253	-	-	-	-	0.4	0.1	-	-	-	-	1	0.2
Subtotal White River NF		21,208	4.3	10.5	4.5	0.5	4.4	4.8	5	15	4	1	5	6.0
All USFS Lands		87,838	22.3	45.2	32.2	17.8	12.0	25.9	28	88.0	48	30.0	17.0	42.2

"-", no flights during that timeframe; "NF", National Forest; "Avg.", average; "Mtn.", mountain.

Even the highest acreage flown constitutes less than 1% of the 10.9 million acres of USFS lands in Colorado. Because only about 1/5 of the total acreages on WS-Colorado agreements are actually flown (WS 1997), we estimate that the amount of USFS lands actually flown by WS-Colorado in any typical year is well below 0.5%. Thus, more than 99.5% of USFS lands were not exposed to any WS-Colorado aerial PDM in a typical year (Table 3-19).

The average number of days flown per year on any USFS allotment ranged from 0.2 to 6.2 flights. Of the 19 allotments flown at some time over the five-year period FY12-16, 13 (68%) were exposed to fewer than 3 flights per year on average. The other 6 allotments (32%) were flown between 3 and 6.2 times per year. Although some allotments were flown more times within any given year, no allotment was flown on more than 15 days in any one year. This constitutes a very small fraction (at most 4%) of the 365 days in a year. Moreover, the average flight time on any USFS allotment was 0.6 hours per flight-day; thus, the amount of time spent flying over any USFS allotment was considerably less than 4% (Table 3-19).

Most of WS-Colorado aerial PDM on USFS lands occurred on just two NFs - the Routt and White River in northwest Colorado (95% or hours flown). On the Routt NF, WS-Colorado flew on an average of 9 (range 7 to 11) grazing allotments per year, which is about 6% (range 5 to 8%) of the 139 grazing allotments on the Routt NF. On a land area basis, the total acreage of allotments flown on the Routt NF averaged 40,931 acres per year (range about 36,000 to 47,000). These acreages constitute 4% to 5% of the 935,782 acres of USFS grazing allotments on the Routt NF. Thus, at least 95% of the grazing allotment area was not exposed to any WS-Colorado aerial PDM in a typical year. In fact, because only about 1/5 of the total acreages on WS-Colorado aerial PDM agreements are actually flown (WS 1997; see Section 3.1.1), it is likely that 99% of Routt NF lands were not exposed to aerial PDM by WS-Colorado in any typical year (Table 3-19).

On the White River NF, WS-Colorado flew on an average of 3 (range 1 to 4) grazing allotments per year, which is about 0.7 to 3% of the 135 allotments on that NF. Therefore, at least 97% of allotments were not exposed to any aerial PDM in a typical year. On a land area basis, the total acreage of allotments flown on the White River NF was 12,259 acres per year (range about 3,000 to 18,000). These acreages constitute 0.2% to 1.2% of the 1,462,365 acres of USFS grazing allotments on the White River NF. Because only about 1/5 of the total acreages on WS-Colorado agreements are actually flown (WS 1997), we estimate that less than 0.5% of White River NF lands were flown in any year. Thus, more than 99.5% of these NF lands were not exposed to any WS-Colorado aerial PDM in a typical year.

The only other NF grazing allotments in the State where WS-Colorado conducted aerial PDM were on the Comanche National Grassland in the Pike/San Isabel NF (0 to 2 allotments flown per year). Total acreage of allotments flown per year ranged from 0 to 15,000, which is 0 to 1% of the total acreage of grazing allotments on the Pike/San Isabel NF. The total grazing allotment acres on the Comanche Ranger District (Comanche NG) is 413,616; therefore, the acres flown ranged from 0 to 3.6% of the grazing allotments of that NG.

3.5.1.3 Overall Impacts on Public lands exposed to WS-Colorado aerial PDM.

During FY12-FY16, WS-Colorado flew an average of 590 hours over an average of 2,331 mi^2 (yearly range 2,015 to 2,582 mi^2) of properties that were under WS-Colorado agreements in Colorado, or about 2.2% (range 1.9 to 2.5%) of the land area of the State in any given year. WS-Colorado aerial PDM activity is minor in terms of geographic scope because more than 97% of the land area in the State is not exposed to any such activity. Of the 590 hours flown annually in that 5 year period, 82% occurred over private lands (average of 482 hours), 13% over BLM lands (average of 78 hours), 4% over USFS lands (average of 26 hours), and less than 1% over other lands (primarily State owned lands) (average of 3 hours). The amount of time spent flying over the properties where aerial PDM was conducted averaged 15 minutes/mi^2 in any given year. Therefore, on the small proportion of the landscape exposed to aerial PDM, such overflights occur during only a tiny fraction of the time in an entire year.

Table 3-20 shows data on WS-Colorado aerial PDM hours by County during FY12-16. WS-Colorado conducts more aerial PDM in northwest Colorado than in any other portion of the State due to its higher numbers of domestic sheep which are more vulnerable to coyote predation than other types of livestock.

Table 3-20. Average annual aerial predator management hours in Colorado by County during federal fiscal year 2012-16.

County	Average Hours[1]	Percentage of Total
Adams	2.1	0.4%
Arapahoe	2.8	0.5%
Baca	0.7	0.1%
Bent	2.6	0.5%
Cheyenne	0.3	0.0%
Crowley	10.2	1.8%
Delta	13.4	2.3%
Eagle	8.1	1.4%
Elbert	7.2	1.3%
Grand	11.1	1.9%
Gunnison	2.1	0.4%
Kiowa	5.3	0.9%
Larimer	1.5	0.3%
Las Animas	0.9	0.2%
Lincoln	5.4	0.9%
Mesa	2.0	0.3%
Moffat	307.9	53.2%
Montezuma	0.1	0.0%
Montrose	29.6	5.1%
Morgan	3.0	0.5%
Otero	7.9	1.4%
Prowers	2.8	0.5%
Pueblo	8.6	1.5%
Rio Blanco	45.5	7.9%
Routt	85.3	14.8%
San Miguel	4.2	0.7%
Washington	4.9	0.9%
Weld	0.1	0.0%
Total[2]	575.8	99.5%

[1] Excludes average of 3.2 hours/year for feral swine.
[2] Total does not equal 100% due to rounding,

About 53%, 15%, and 8% (sum of 76%) of WS-Colorado aerial PDM hours occurred in Moffat, Routt, and Rio Blanco Counties, respectively. Lesser amounts occurred in several counties in north-central (Grand County), west-central (Mesa, Delta, Montrose, Eagle, Gunnison, and San Miguel, Counties), south-western (Montezuma County), and eastern (Adams, Arapahoe, Baca, Bent, Cheyenne, Crowley, Elbert, Kiowa, Larimer, Las Animas, Lincoln, Morgan, Otero, Prowers, Pueblo, Washington, and Weld Counties) portions of Colorado.

3.5.1.4 Effects of WS-Colorado PDM on Special Management Areas.

A number of different types of Federal lands occur within the analysis area such as WAs, WSAs, Future Planning Areas, National Conservation Areas, National Historic Sites, and Areas of Critical Environmental Concern. All of these land types currently have special designations because of their unique characteristics and may require special considerations for conducting PDM. These are collectively referred to as Special Management Areas (SMAs). WS-Colorado recognizes that some persons interested in SMAs may feel that any PDM activity in these areas adversely affects aesthetics, natural qualities, values, or the ecosystem. But many SMAs have allowed grazing since long before their designation as an SMA, and continue to allow it. Current laws and regulations allow the public and WS-Colorado to conduct PDM activities in SMAs under certain limitations. As such, WS-Colorado has conducted PDM on some of these areas. However, PDM on SMAs includes only a few grazing allotments for the protection of livestock in recent years, and we do not anticipate any substantial increase in the future. PDM in SMAs is only a very minor component of the current PDM program. WS-Colorado complies with internal guidelines and policies when conducting PDM in these areas. WS-Colorado also abides by all federal and state laws, regulations, and policies set forth for these SMAs (*e.g.*, the Wilderness Act) to minimize any effect on the public. Currently, private individuals using firearms and trail hounds can sport hunt or conduct PDM in most SMAs under CPW or CDA regulations. These activities are not restricted by BLM or USFS in most SMAs.

WS-Colorado recognizes that some individuals interested in SMAs may feel that any PDM activities in these areas adversely affect their aesthetic and natural qualities, value, and the ecosystem. This issue was discussed in Chapter 2, as well as WS-Colorado's protective measures to ensure no adverse effects in SMAs. WS-Colorado abides by all associated laws, regulations, and policies (*e.g.*, the Wilderness Act) to minimize any effect on the public while conducting PDM as allowed to reduce damage in the SMAs or surrounding areas. WS-Colorado also complies with WS guidelines and policies when conducting PDM in these areas. PDM is only conducted in designated WAs or WSAs when allowed by the legislation that designated the WA, or under regulations and policies developed by USFS or BLM for PDM in these areas. WS-Colorado has conducted a minimum requirements analysis for protection of livestock from predation in wilderness areas. Normally, minimum requirements analyses are conducted by the land management agencies: USFS or BLM.

WS-Colorado generally conducts PDM on only a few SMA grazing allotments for the protection of livestock. During FY12-16, WS-Colorado conducted PDM on 1 SMA on USFS land, and no SMAs on BLM land. The Current Program Alternative has a minimal effect on SMAs, such as WAs, WSAs, campgrounds, research natural areas, trailheads, and National Conservation Areas.

<u>BLM SMAs</u>: WS-Colorado PDM in WAs, WSAs, and other SMAs conforms with all federal and state laws and regulations that have been determined to apply to WS-Colorado activities. WS-Colorado PDM in SMAs has occurred only to a very minor degree in the current program and the need for such activity in SMAs is expected to remain minor. The BLM has not imposed any restrictions on most PDM methods in any SMAs in the State. Previously, the only exception was in the BLM Interim Management Policy and Guidelines for Lands Under Wilderness Review

(BLM 1995), which established several restrictions on PDM in WSAs[6]. That policy did not purport to restrict the use of other PDM methods, including those that are also involved in sport hunting and private or state agency PDM activities, such as the use of firearms or trail hunting dogs. Therefore, the use of such methods under WS authorities would be consistent with BLM management direction in such areas. BLM revised its policy for management of WSAs in 2004 (C. McCluskey, Senior Wildlife Specialist, BLM, pers. comm. 2005).

WS-Colorado coordinates annually with the BLM, which provides the BLM with the opportunity to identify any conflicts that WS-Colorado activities might have with established management plans or goals for SMAs. If WS-Colorado activities are found to conflict with such management plans or goals, then WS-Colorado will either avoid conducting the activity or engage in further NEPA analysis as appropriate in coordination with the BLM. During FY12-16, WS-Colorado did not conduct any PDM activities, including aerial PDM, in any BLM SMA's.

USFS SMAs: WS-Colorado follows policies outlined in the USFS Manual, particularly Section 2323, and the National MOU between USFS and WS-Colorado when conducting PDM in USFS SMAs such as WAs, WSAs, and Future Planning Areas. Additionally, the LRMP provides guidance for USFS to determine if PDM objectives are compatible with land management objectives. For example, WS-Colorado does not conduct PDM in USFS specially designated areas (*e.g.*, trailheads, campgrounds), except for emergency human health situations. Proposed WS-Colorado PDM plans (ADMs) are reviewed by USFS during the work planning process to ensure that there are no conflicts with the LRMP. Therefore, we expect no potential for WS-Colorado PDM to have any adverse effect on wilderness characteristics or management objectives of SMAs. Proposed PDM in USFS SMAs is primarily limited to grazing allotments with a limited buffer zone for the protection of livestock, but could also occur on occasion for the protection of wildlife if requested by CPW. PDM in SMAs would not impair the values of such areas and the intent of Congress designating them as such.

WS-Colorado PDM activity on USFS SMAs has been very limited. During FY12-16, WS-Colorado conducted PDM on 1 USFS SMA: the Weminuche WA. WS-Colorado has been asked to conduct PDM in the Powder Horn and Lizard Head WAs, but no actions have been taken in these areas during FY12-16. In the Weminuche WA, WS-Colorado used calling and shooting to target coyotes, and trail dogs to target black bear in efforts to limit sheep losses from these predators. Total WS-Colorado take in this WS was 3 coyotes and 2 black bears during FY12-16 (average of 0.6 coyotes and 0.4 black bears per year). WS agreements on the Weminuche WA cover approximately 38 mi^2 of the WA; however, the land area actually worked was likely less than 1/5 of the total area under agreement (<7.6 mi^2) (WS 1997). WS-Colorado did not conduct any aerial PDM in any FS WAs during FY12-16.

Summary of Potential Impacts to SMAs in Colorado: Colorado has many SMAs. A list of the majority of SMAs in Colorado is provided in Table 3-21. These areas were analyzed to determine potential impacts of the current WS-Colorado program on their unique characteristics. The various SMAs are managed for the protection of certain qualities or values such as biological (*e.g.*, sensitive plant or animal species), ecological (*e.g.*, riparian, rangeland), cultural, historical, scenic, geological, paleontological, or recreational. Many of these resource values do not have the potential to be impacted by the PDM methods that WS-Colorado might use on such areas (*e.g.*, aerial PDM, ground-based shooting).

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[6] For example, requirements to target individual offending animals and to obtain BLM State Director approval before aerial hunting may occur. These requirements were eliminated by policy revision in 2004.

Table 3-21. Special Management Areas (SMAs) in Colorado (list is not intended to be comprehensive).		
COLORADO WILDERNESS AREAS / NATIONAL PARKS / HISTORIC SITES		
Bents Old Fort National Historic Site (NPS) Black Canyon of the Gunnison National Park (15,599 acres) Black Ridge Canyons (Grand Jct RA) Byers Peak (8,913 acres, Arapaho, Routt NFs) Collegiate Peaks (166,938 acres, White River, San Isabel, Gunnison NF) Cache La Poudre (9,238 acres, Roosevelt NF) Buffalo Peaks (43,410, Pike, San Isabel NFs) Colorado National Monument (NPS) Comanche Peak (66,791 acres, Roosevelt NF) Curecant National Recreation Area (NPS) Dinosaur National Park (210,000 acres, NPS) Eagles Nest (132,906 acres, Arap., White River NFs) Flat Tops (235,035 acres, Routt, White River NFs) Florissant Fossil Beds National Monument (NPS)	Great Sand Dunes National Park/Preserve (33,450 acres, NPS, San Isabel NF) Greenhorn Mountain (22,040 acres, San Isabel NF) Gunnison Gorge (17,700 acres, Gunnison NF, Uncompahgre RA) Holy Cross (122,797 acres, San Isabel, White River NF) Hunter - Fryingpan (81,866 acres, White River NF) Indian Peaks (73,291 acres, Arapaho, Roosevelt NFs) La Garita (128,858 acres, Gunnison, Rio Grande NFs) Lizard Head (41,193 acres, San Juan, Uncompahgre NFs) Lost Creek (119,790 acres, Pike NF) Maroon Bells - Snowmass (181,117 acres, Gunnison, White River NFs) Mesa Verde National Monument (8,100 acres, NPS) Mount Evans (74,401 acres, Arapaho, Pike NFs) Mount Massive (30,540 acres, San Isabel NF) Mount Sneffels (16,565 acres, Uncompahgre NF) Mount Zirkel (159,935 acres, Routt NF)	Neota (9,924 acres, Roosevelt, Routt NFs) Never Summer (20,747 acres, Arapaho, Routt NFs) Platte River (23,492 acres, Routt NF) Powderhorn (61,510 acres, Gunnison NF, Gunnison RA) Ptarmigan Peak (12,594 acres, Routt, White River NFs) Raggeds (64,992 acres, Gunnison, White River NFs) Rawah (73,068 acres, Roosevelt, Routt NFs) Rocky Mountain National Park (210,000 acres, NPS) Sand Creek Massacre National Historic Site (NPS) Sangre De Cristo (226,420 acres, Rio Grande, San Isabel NFs) Sarvis Creek (47,190 acres, Routt NF) South San Juan (158,790 acres, Rio Grande, San Juan NFs) Uncompahgre (102,721 acres, Uncompahgre NF) Vasquez (12,986 acres, Arapaho, Routt NFs) Weminuche (492,418 acres, San Juan, Rio Grande NFs) West Elk (176,172 acres, Gunnison NF)
WILDERNESS STUDY AREAS AND FUTURE PLANNING AREAS		
Adobe Badlands (Uncompahgre RA) American Flats (Gunnison RA) Bangs Canyon (Grand Jct RA) Beaver Creek (Royal Gorge RA) Black Mountain/Windy Gulch (White River RA) Browns Canyon (Royal Gorge RA) Bull Canyon (White River RA) Bull Gulch (Glenwood RA) Camel Back (Uncompahgre RA) Cahone Canyon (San Juan RA) Castle Peak (Glenwood RA) Cold Springs Mountain (Little Snake RA) Cross Canyon (San Juan RA) Cross Mountain (Little Snake RA) Deep Creek (Glenwood RA) Demaree Canyon (Grand Jct RA) Diamond Breaks (Little Snake RA) Dinosaur National Monument Additions - Ant Hills, Chew Winter Camp, Peterson Draw, Tepee Draw, Vale of Tears (Little Snake RA)	Dolores River Canyon (San Juan, Uncompahgre RAs) Dominguez Canyon (Grand Jct, Uncompahgre RAS) Flat Tops Addition - Hack Lake (Glenwood RA) Granite Creek (Uncompahgre RA) Grape Creek (Royal Gorge RA) Great Sand Dunes Addition (La Jara RA) Gunnison Gorge (Uncompahgre RA) Handies Peak (Gunnison RA) Hunter Canyon (Grand Jct RA) James Peak SMA (Arapaho NF) Little Bookcliffs (Grand Jct RA) Mares Tail -Squaw/Papoose Canyons (San Juan RA), Maroon Bells-Snowmass Additions (Glenwood RA) McIntyre Hills (Royal Gorge RA) McKenna Peak (San Juan RA) Oil Springs Mountain (White River RA) Piedra SMA (San Juan NF) Pinion Ridge (White River RA) Platte River Addition (Kremmling RA)	Redcloud (Gunnison RA) Rio Grande (La Jara RA) Roan Plateau (Grand Jct RA) Roubideau (Uncompahgre NF/RA) San Luis Hills (La Jara RA) Sewemup Mesa (Grand Jct RA) Skull Creek (White River RA) Snaggletooth (San Juan RA) South Shale Ridge (Grand Jct RA) Tabeguache SMA (Uncompahgre NF/RA) The Palisade (Grand Jct RA) Thompson Creek (Glenwood RA) Troublesome (Kremmling RA) Unaweep (Grand Jct RA) Vermillion Basin (Little Snake RA) Weber-Menefee Mountains (San Juan RA) West Elk Addition (Gunnison RA) Willow Creek (White River RA) Yampa River (Little Snake RA)
NATURAL AREAS BY COUNTY		
ALAMOSA - Zapata Falls BACA - Comanche Grassland, Shell Rock Canyon BOULDER - Colorado Tallgrass Prairie, South Boulder Creek, White Rocks CHAFFEE - Droney Gulch CLEAR CREEK - Mount Goliath CONEJOS - Rajadero Canyon CUSTER - Brush Creek Fen DELTA - Needle Rock DOLORES - Narraguinep DOUGLAS - Castlewood Canyon, Roxborough State Park EL PASO - Aiken Canyon, Hurricane Canyon FREMONT - Arkansas Canyonlands, Garden Park Fossil Locality, High Mesa Grassland, Indian Springs Trace Fossil Locality, and Mini-Wheeler (Stirrup Ranch Geologic), Phantom Canyon	GRAND - Kremmling Cretaceous Ammonite Locality, Paradise Park GUNNISON - Gothic, Mexican Cut, Mount Emmons Iron Bog, and South Beaver Creek HINSDALE - Redcloud Peak, Slumgullion Earthflow HUERFANO - Cucharas Canyon JACKSON - East Sand Dunes, North Park JEFFERSON - Dakota Hogback, Ken-Caryl Ranch LARIMER - Blue Mountain - Little Thompson, Owl Canyon, Pinyon Grove, Jimmy Creek, Park Creek, Sand Creek, Specimen Mountain, and West Creek LOGAN - Tamarack Ranch MESA - Badger Wash, Fruita Paleontological Locality, Gateway Palisade, Gunnison Gravels, Pyramid Rock, Rabbit Valley, Rough Canyon, and Unaweep Seep MINERAL - Wheeler Geologic MOFFAT - Cross Mountain Canyon, Irish Canyon, Limestone Ridge, Lookout Mountain MONTEZUMA - McElmo	MONTROSE - Escalante Canyon, Fairview, San Miguel River at Tabeguache Creek PARK - High Creek Fen, Saddle Mountain, Treasurevault Mountain RIO BLANCO - Black Gulch, Coal Draw, Coal Rim, Deer RIO BLANCO - Black Gulch, Coal Draw, Coal Rim, Deer Gulch, Duck Creek, Dudley Bluffs, East Douglas, Lower Greasewood Creek, Raven Ridge, South Cathedral Bluffs, Yanks Gulch / Upper Greasewood Creek RIO GRANDE - Elephant Rocks ROUTT - California Park SAGUACHE - Indian Spring, Mishak Lakes SUMMIT - Mosquito Pass TELLER - Dome Rock WELD - Chalk Bluffs YUMA - Bonny Prairie

PDM as conducted by WS-Colorado does not have an impact on ecological, cultural, historical, geological, paleontological, or plant resources because habitat is not impacted by WS-Colorado during PDM. WS-Colorado PDM also does not impact amphibians, fish, or invertebrates in Colorado. PDM has no potential to affect scenic qualities and has only minor potential to affect aesthetic and recreational qualities of SMAs because WS-Colorado works on relatively few SMAs, and such work is limited in scope and duration, as discussed in this section. Although WS-Colorado has the potential to take some species of birds and mammals during PDM, WS-

Colorado is not likely to impact these species under the current program (see Sections 3.1 and 3.2).

Several SMAs have been set aside for wildlife protection, especially big game wintering areas. Other protected wildlife species which are found on some of the SMAs include T&E species (Table 3-15a) and sensitive species (Table 3-22).

Table 3-22. Sensitive mammal and bird species found in Natural Areas and other Special Management Areas (SMAs) in Colorado. WS-Colorado conducts little predator damage management on SMAs in Colorado and methods are restricted by Amendment 14. The only species potentially impacted by PDM is the swift fox. Data from Rondeau *et al.* 2011

Species	Scientific Name	CNHP State Rank	Where Found	Habitat	When Found	Effects of PDM
MAMMALS						
Cliff Chipmunk	*Tamias dorsalis*	S2	Moffat Co.	Pinyon-juniper	All year	0
Dwarf Shrew	*Sorex nanus*	S2	Central Foothill	Woods	All year	0
Ord's Kangaroo Rat	*Dipodomys ordii priscus*	S3	Moffat Co.	Open sandy	All year	0
Pygmy Shrew	*Sorex hoyi montanus*	S2	Jackson Co.	Wooded-open	All year	0
Silky Pocket Mouse	*Perognathus flavus sanluisi*	S3	San Luis Valley	Shortgrass	All year	0
White-tailed Prairie Dog	*Cynomys leucurus*	S4	Northwest	Prairie	All year	0
Brazilian Free-tailed Bat	*Tadarida brasiliensis*	S1	Scattered sites	Caves-bldgs.	Summer	0
Swift Fox	*Vulpes velox*	S3	Eastern Colo.	Plains	All year	-, 0, +
BIRDS						
American peregrine falcon	*Falco peregrinus anatum*	S3	Western Colo.	Variety	All year	0
Black swift	*Cypseloides niger*	S3	Western Colo.	Cliffs	Summer	0
Bobolink	*Dolichonyx oryzivorus*	S3	North-central	Grassland	Breed	0
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	S2	Western Colo.	Grass-shrublands	All year	0, +
Grace's warbler	*Dendroica graciae*	S3	Southwest	Pine-oak	Breed	0
Gray vireo	*Vireo vicinior*	S2	Western Colo.	Pinyon-juniper	Breed	0
Greater sandhill crane	*Grus canadensis tabida*	S2	Northwest	Marsh-grassland	Breed S	0, +
Lewis's woodpecker	*Melanerpes lewis*	S4	Western Colo.	Open woodlands	All year	0
Northern sage-grouse	*Centrocercus urophasianus*	S4	Northwest	Sage	All year	0, +
Ovenbird	*Seiurus aurocapillus*	S2	Eastern Colo.	Decid. oldgrowth	Breed	0
Prairie falcon	*Falco mexicanus*	S4	Statewide	Prairie	All year	0
Sage sparrow	*Amphispiza belli*	S2	Western Colo.	Sage	Breed	0
White-faced ibis	*Plegadis chihi*	S2	Statewide	Marsh-grassland	Breed	0, +
Black-necked stilt	*Himantopus mexicanus*	S3	Statewide	Wetlands	Breed	0, +
Boreal owl	*Aegolius funereus*	S2	North-central	Boreal forest	All year	0
Brown-capped rosy-finch	*Leucosticte australis*	S3	Western Colo.	Alpine	All year	0
Ferruginous hawk	*Buteo regalis*	S3	Statewide	Open Prairie	All year	0
Greater prairie-chicken	*Tympanuchus cupido*	S3	Northeast	Grassland	All year	0, +
McCown's longspur	*Calcarius mccownii*	S3	North-central	Grassland	Breed	0
Mountain plover	*Charadrius montanus*	S2	Eastern Colo.	Prairie	Breed	0
Northern goshawk	*Accipiter gentilis*	S3	Western Colo.	Forest	All year	0
Northern pygmy-owl	*Glaucidium gnoma*	S3	Western Colo.	Woodlands	All year	0
Veery	*Catharus fuscescens*	S3	Western Colo.	Moist woods	Breed	0
White-tailed ptarmigan	*Lagopus leucurus*	S4	Central Colo.	Alpine	All year	0, +
White-winged crossbill	*Loxia leucoptera*	S1	Western Colo.	Conifer forest	Winter	0
Willow flycatcher	*Empidonax traillii*	S4	Statewide	Riparian woods	Breed	0
Wilson's phalarope	*Phalaropus tricolor*	S4	Statewide	Wetland	Breed	0

CNHP = Colorado Natural Heritage Program   Effects of PDM: (-), negative; (+), positive; 0, no effect

State Rank (relative rarity or endangerment in the state): S1-Critically imperiled; S2-Imperiled; S3-Rare; S4-Widespread, but long-term concern

If an SMA has been specifically designated to protect a wildlife species that could potentially be impacted by PDM, then special restrictions might be needed. In general, PDM has not been necessary in these areas, primarily because livestock are not often allowed to graze on them. However, PDM may be conducted on such areas if the need arises, especially during a human health and safety crisis. Similar to other types of BLM and USFS SMAs discussed above, sport hunting and PDM by private individuals using firearms and trail hounds generally is not restricted in these areas. The land management agency is responsible for identifying any conflicts that PDM might have with the management of an SMA, during the interagency coordination process. For example, if the land management agency determines that an area with special management emphasis is to be closed to all access and/or the use of firearms, or to all low level flights, then those restrictions would be included in the ADM, and WS-Colorado would abide by those restrictions unless provided with a special exemption.

Table 3-22 lists the species being monitored in Natural Areas in Colorado. Of these, the only species with the potential to be negatively impacted by WS-Colorado PDM is the swift fox. Such impacts would be negligible, as discussed in Section 3.1. WS-Colorado PDM is restricted in these areas to target-specific methods; thus, WS-Colorado PDM does not negatively impact such sensitive species. In fact, WS-Colorado PDM may benefit some of these species. Of the species listed, WS-Colorado PDM could potentially benefit 8 species by removing predators that prey on them or their nests.

3.5.1.5 Conclusions for Direct, Indirect, and Cumulative Impacts of WS-Colorado PDM on Public Lands under Alternative 1.

WS-Colorado aerial PDM on public lands in Colorado has been infrequent, of short duration, and over a small proportion of the total public lands in the State. Even within the specific BLM RAs and USFS NFs where WS-Colorado conducted the most PDM and the most aerial PDM, the vast majority of the land area was not exposed to aerial PDM flights or other PDM activities, and these actions were limited to only a small fraction of time in any year. Most recreationists are totally unaware of PDM actions, and the quality of their outdoor experience is unaffected. Thus, WS-Colorado PDM has had no significant impact on recreational uses.

WS-Colorado uses work planning coordination with the BLM and USFS to further lessen the potential for impacts on recreation on public lands, including SMAs. During such coordination, the Federal land managers, and CPW personnel, inform WS-Colorado about specific locations where mitigation or restrictions on WS-Colorado PDM activities might be necessary to reduce or eliminate the potential for adverse effects on specific resources. For example, high-use recreational areas are identified and avoided when WS-Colorado conducts PDM. Furthermore, upland game and other high-use hunting areas are delineated by CPW, USFS, or BLM. If WS-Colorado works in these areas, control equipment is removed a week or more prior to the hunting season as appropriate. WS-Colorado does not conduct PDM in high-use recreational areas except for the protection of human health and safety. High use recreation and other sensitive areas are identified at the site specific level in ADMs and on ADM maps, which are modified as new damage situations arise. Human safety zones, planned PDM areas, and restricted or coordinated PDM areas are identified through interagency communications and included in the ADMs. We rely on these processes to assist in avoiding substantive adverse effects on recreational opportunities or other relevant components of the human environment.

Game and non-game wildlife populations are not significantly impacted by WS-Colorado's minimal take on public lands (also see Sections 3.1 and 3.2), allowing hunters ample opportunity for pursuit. Recreationists interested in wildlife viewing and photography opportunities also have ample areas on public lands in Colorado which are suitable for seeing abundant wildlife. In fact, WS-Colorado PDM activities may benefit certain wildlife populations thereby increasing recreational opportunities.

Potential conflicts with recreationists are further minimized due to the inherent nature of PDM. WS-Colorado conducts PDM on public lands almost entirely for the protection of sheep and cattle on grazing allotments. Many of these areas are generally not used extensively by recreationists. Most recreational areas are set aside for that specific purpose, and grazing is not allowed. The highest seasonal PDM activity for the protection of livestock immediately precedes or coincides with lambing and calving, which is mostly in the spring. During these times (later winter and early spring), aerial PDM is the method of choice, because of limited access due to wet or snow covered roads. Many recreationists, as well as WS-Colorado Specialists, do not have access to these public lands due to these natural limitations.

Our analyses slightly overestimate the potential for impact on these public lands, because data were included for many WS agreements which include some private land in addition to BLM or USFS land. In these cases, some of the PDM work was conducted on private land, and some on public land; however, our analysis was not able to differentiate these land classes in many cases. As such, some of the work conducted on these private lands is included in our analysis of these public lands.

Under Alternative 1, WS-Colorado expects continued annual variation in the specific allotments and acreages on which PDM is conducted, and in the numbers of predators taken, much like the yearly variations in this analysis. However, WS-Colorado does not anticipate any substantive future increases these acreages, numbers of allotments, frequency, or duration of PDM on public lands. We also do not anticipate any substantive increase in the number of predators taken in the future, except for black bears, which were discussed in Section 3.1.

Under Alternative 1, there would be no significant cumulative impacts on public lands.

3.5.2 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

Direct actions by WS-Colorado would minimally affect recreationists under this Alternative (similar to Alternative 1). In areas where lethal preventive control would have been used by WS-Colorado under Alternative 1, PDM would likely be implemented by resource owners or private contractors instead, or by WS-Colorado later in the year (after damage had occurred). Under Alternative 2, aerial PDM would be used less because it is the most common preventive method used by WS-Colorado. Instead, private individuals/entities would likely conduct most preventive PDM. Because aerial PDM is not available to private entities on public lands, they would be restricted to the use of less effective methods. As such, they might spend more time conducting PDM on public lands than what would be conducted under Alternative 1. More losses would likely be incurred by resource owners without aerial PDM (Wagner 1997, Wagner and Conover 1999), and therefore, even more PDM efforts would be expended following these higher losses. Such an increase would likely be minimal, though, due to increased costs. Slight increases in PDM activities, use of improper or illegal methods, and off-road vehicle use would be likely under Alternative 2. These additional impacts would likely be lower than under Alternatives 3 and 4, because WS-Colorado would still conduct lethal control after damage has occurred. WS-Colorado would conduct less aerial PDM on public lands under this Alternative. The overall impacts on recreation under Alternative 2 would likely be similar to those under Alternative 1. Under Alternative 2, there would be no significant impacts on public lands.

3.5.3 Alternative 3 - WS-Colorado Provides Technical Assistance Only.

Under this alternative, WS-Colorado would not have any direct impact on recreational use of public lands in Colorado. However, this Alternative would cause many of the same problems discussed for Alternative 2, except at higher levels: increased private PDM activities due to lower efficacy, off-road use, and the use of improper or illegal methods. The potential for negative impacts would be reduced compared to Alternative 4, because those receiving advice from WS-Colorado would likely make wiser choices when conducting PDM on public lands. However, this Alternative would likely result in slightly greater negative impacts on recreation than would the Proposed Action (Alternative 1).

Impacts on SMAs would likely be the same as those under Alternative 1, because private entities do not conduct PDM on most or all SMAs. Overall, impacts on public lands would likely be somewhat higher under Alternative 3 (compared to Alternative 1), but these impacts would not likely reach the level of significant impact.

3.5.4 Alternative 4 – No PDM by WS-Colorado.

Under this alternative, WS-Colorado would not provide assistance with PDM; therefore, there would be no direct Federal impact on recreation. However, CDA and CPW would probably provide some level of direct PDM assistance, and PDM by private individuals and entities would likely increase, as discussed for Alternative 3 above (Section 3.5.3).

Impacts might be slightly higher under this alternative than those under Alternative 3, because WS-Colorado would not provide any technical assistance, which would likely have recommended less impactful methods. Impacts on SMAs would likely be the same as those under Alternative 1, because private entities do not conduct PDM on most or all SMAs. Overall, impacts on public lands would likely be somewhat higher under Alternative 4 (compared to Alternative 1), but these impacts would not likely reach the level of significant impact.

3.6 Issue F: Other Sociocultural Issues

Wildlife is generally regarded as providing aesthetic, recreational, and economic benefits (Decker and Goff 1987), and the mere knowledge that wildlife exists is a positive benefit to many people. Some members of the public have expressed concerns that PDM could result in the loss of aesthetic benefits to the public, resource owners, or local residents. Aesthetics is the philosophy dealing with the nature of beauty, or the appreciation of beauty. Therefore, aesthetics is truly subjective, and dependent on what an observer regards as beautiful. Other sociocultural issues concerning wildlife include humanness and ethics, impacts on hunting and trapping opportunities, and Native American cultural concerns.

3.6.1 Alternative 1 - Continue the Current Federal PDM Program.

Under Alternative 1, WS-Colorado would continue the current program of integrated and adaptive PDM, using the Decision Model, protective measures, and APHIS-WS policies and directives. WS-Colorado PDM activities occur on a limited proportion of the total land area in Colorado (<1% in FY12-16), and the proportion of various predator species' populations removed through WS-Colorado PDM activities is typically small (Section 3.1.1). In localized areas where WS-Colorado removes predators, dispersal of predators from adjacent areas typically contributes to repopulation of the area within a few months to a year, depending on the level of predator removal and predator population levels in nearby areas. Most of the species targeted by WS-Colorado PDM activities are relatively abundant, but are not commonly observed because many of these species are secretive and/or nocturnal. The likelihood of getting to see or hear a predator in some localized areas could be temporarily reduced as a result of WS-Colorado PDM, but because there is already a low likelihood of seeing a predator, this temporary local reduction in public viewing opportunity would not likely be noticeable in most cases. The opportunities to view, hear, or see evidence of predators would still be available over the vast majority of public land areas of the state because WS-Colorado conducts PDM on a small percentage of BLM and USFS lands, as analyzed in Section 3.5.1.

3.6.1.1 Humaneness and Ethical Perspectives

Alternative 1 might be unacceptable to some animal rights advocates, individuals with strong humanistic and moralistic values, or to others with strong emotional or spiritual bonds with certain wildlife species. Some individuals assert that killing the offending animal is not the response of a moral or enlightened society. Response of other individuals and groups vary, depending on individual assessments of the need for damage management, risk to the target animal population, risk to non-target species and individuals, the degree to which efforts are made to avoid or minimize the pain and suffering associated with the various management techniques, and the perceived humaneness of individual methods. Increasing portions of the population showing mutualistic values (George *et al.* 2016) will be concerned regarding humaneness of individual methods, and the potential for any level of lethal PDM to adversely impact predator populations and ecosystems. Some people express mutualistic values (George *et al.* 2016) or naturalistic values (Kellert *et al.* 1984) towards WDM and PDM. These values can be simplistically expressed as allowing nature to take its own course.

Selectivity of Methods: Selectivity of PDM methods is related to the issue of humaneness in that greater selectivity results in less perceived suffering of non-target animals. The selectivity of each method is based, in part, on the skill and discretion of the WS-Colorado Specialist in applying such methods, and also on specific protective measures and modifications designed to reduce or minimize non-target captures. The humaneness of a given PDM method is based on the human perception of the pain or anxiety caused to the animal by the method. How each method is perceived often varies, depending on the person's familiarity and perception of the issue. The selectivity and humaneness of each alternative are based on the methods employed, and who employs them under the different alternatives. With the passage of Amendment 14, the pool of experienced private predator trappers is diminishing because recreational trapping is no longer allowed; this increases the number of inexperienced trappers using PDM methods.

Schmidt and Brunson (1995) conducted a public attitude survey in which respondents were asked to rate a variety of WDM methods on humaneness, based on their individual perceptions of the methods. They found that the public believes that nonlethal methods such as animal husbandry, fences, and scare devices were the most humane; and that traps, snares, and aerial PDM were the least humane.

The AVMA has described euthanasia as "*ending the life of an individual animal in a way that minimizes or eliminates pain and distress*" (AVMA 2013). Some people would prefer that only accepted methods of euthanasia be used when killing any animal, including wild and feral animals. Indeed, WS strives to use the most humane methods practical in order to minimize such pain or distress. However, as noted by the AVMA (2013), "*the quickest and most humane means of terminating the life of free-ranging wildlife in a given situation may not always meet all criteria established for euthanasia*." They have also stated that "*For wild and feral animals, many of the recommended means of euthanasia for captive animals are not feasible. In field circumstances, wildlife biologists generally do not use the term euthanasia, but use terms such as killing, collecting or harvesting, recognizing that a distress-free death may not be possible*" (AVMA 2001). The distinction here is between a distress-free death, and a humane death which minimizes pain and distress. Some individuals and groups are opposed to some of the PDM actions of WS. However, WS personnel are experienced and professional in their use of PDM methods. This experience and professionalism allows WS personnel to use equipment and techniques that are as humane as possible within the constraints of current technology. In fact, this is consistent with another description of euthanasia: "*the humane termination of an animal's life*" (AVMA 2013). In fact, professional PDM activities are often more humane than nature itself (*e.g.*, death from starvation) because these activities can produce quicker deaths that cause less suffering.

Some animal welfare organizations are concerned that certain methods used to manage wildlife damage expose animals to unnecessary pain and suffering. Research suggests that with methods such as restraint in foothold traps, changes in the blood chemistry of trapped animals indicate "stress." Blood measurements of fox indicate that this is the case for fox that have been held in traps (Gorajewska *et al.* 2015). The situation is likely to be similar for other animals caught in traps, snares, or chased by dogs.

The killing of predators during the spring months also has the potential to result in litters of coyotes, red fox, and badgers becoming orphaned. When WS-Colorado conducts aerial PDM activities during the April-June period, aerial PDM crews will sometimes kill one or both of a pair of coyotes which likely have a den of pups in the vicinity. WS-Colorado's field personnel typically search both from the air and on the ground in a concerted effort to locate the den in these cases in order to dispatch the pups, typically through the use of EPA-registered den fumigant gas cartridges. If the den cannot be located, pups may sometimes be fed and cared for by one or more members of a social group of coyotes associated with that den (Bekoff and Wells 1982). There are likely some cases where the killing of coyotes, red fox, or other predators may result in the orphaning of young animals that are still dependent on parental care. The only way to totally avoid this circumstance would be to refrain from conducting any predator removal efforts during this period of time. Unfortunately, this is also the period during which some of the most serious predation problems occur, such as coyotes killing young lambs to feed their pups (Till and Knowlton 1983).

Analysis of this issue must consider not only the welfare of the animals captured, but also the welfare of humans, livestock, and some T&E species if damage management methods are not used. For example, some individuals may perceive techniques used to remove a predator that is killing or injuring pets or livestock as inhumane, whereas others may believe it is equally or more inhumane to permit pets and livestock that depend upon humans for protection to be injured or killed by predators. Use of livestock guarding animals is commonly considered a humane management alternative, but in some areas, livestock guarding animals and dogs used to pursue mountain lions or black bears may also be injured or killed.

The challenge in coping with this issue is how to achieve the least amount of animal suffering with the constraints imposed by current technology. WS-Colorado personnel are concerned about animal welfare. WS-Colorado is aware that techniques like snares and traps are controversial, but also believes that these activities are being conducted as humanely and responsibly as practical. APHIS-WS and the NWRC are striving to bring additional nonlethal damage management alternatives into practical use, and to improve the selectivity and humaneness of management devices. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations when nonlethal damage management methods are not practical or effective. WS-Colorado supports the most humane, selective, and effective damage management techniques, and would continue to incorporate advances into program activities under Alternative 1. WS-Colorado Specialists conducting PDM are highly experienced professionals skilled in the use of management methods, and committed to minimizing pain and suffering. WS Program Directives, protective measures, and training work to ensure that WS-Colorado's PDM methods are used in a manner that is as humane and selective as possible.

Best Management Practices for Trapping: Other practices which help to improve the efficacy, selectivity, and humaneness of WS-Colorado's use of PDM methods include implementing Trapping Best Management Practices (BMPs) where appropriate for PDM actions, and complying with regulations on trap check intervals.

Trapping BMPs are based on scientific evaluations of humaneness, efficiency, selectivity, practicality, and safety. Traps which conform to established thresholds are considered "BMP traps". Trapping components, systems, and techniques are also included in BMPs (*e.g.*, anchoring systems, modifications, pan-tension devices, trap tuning and maintenance, lures and baits, trap location) (AFWA 2006).

In 1997, CPW regulations published pursuant to the passage of Amendment 14 to the Colorado Constitution identified various trap requirements in order to meet the intent of "humane methods" under Colorado Revised Statute 33-6-201. These requirements, such as the use of padded jaw traps, were largely based on opinions, because little scientific information was available at the time. Modern BMPs are based on more than 20 years of scientific research (AFWA 2006), and provide a standard framework for future updates as new traps and components are developed. These BMPs provide a more useful method for identifying the most humane traps. Accordingly, in 2017, CPW updated their wildlife damage regulations to allow broader use of humane animal traps, based on BMPs.

Use of foot snares to catch mountain lions: Foot snares are used to capture mountain lions for research and wildlife damage management in Colorado. Foot snares are an effective tool with 98% of lions captured without debilitating injuries (Logan *et al.* 1999). The snares are set on the ground where lions use trails or around carcasses killed by the lions. The snares capture the lion around the foot or just above the foot capturing the lion alive. The use of foot snares has evolved in recent decades, with improvements reducing injuries. Many of these improvements are described by Logan *et al.* (1999) and AFWA (2009). Foot snares can capture non-target wildlife (*e.g.*, deer, coyotes, foxes, and livestock) (Logan *et al.* 1999). However, incidental take of non-target wildlife can be reduced by the use of pan tension devices, slide stops to minimize snare loop diameter when closed, and foot snare placement (Logan *et al.* 1999). WS-Colorado uses foot snares infrequently.

Use of hounds to catch mountain lions and bears: Hounds are used to capture mountain lions for research, wildlife damage management, and regulated sport hunting. Some commenters on this EA have asserted that the use of hounds is inhumane, citing a study by Elbroch *et al.* (2013), who had very high mortality and injury rates from the use of hounds to capture mountain lions in Chilean Patagonia. These authors reported that 86% of mountain lions were injured and/or killed by the hounds, including a 15% death rate. They suggested that foot snares would be more ethical due to lower injury and death rates, and they recommended a series of nine guidelines for using hounds to capture mountain lions in order to decrease injury and death rates. WS-Colorado has been using most of these recommendations for decades. The only recommendations that WS-Colorado does not routinely utilize is to limit the number of hounds to three (or less). WS-Colorado employees usually run 4-8 dogs to capture depredating mountain lions or black bears. This is based on more than 90 years of combined experience of WS-Colorado personnel, who achieve considerably lower injury and death rates that Elbroch *et al.* (2013).

The 86% injury/death rate and the 15% death rate reported by Elbroch *et al.* (2013) is alarming, but it is not representative of the use of hounds for capturing mountain lions. A number of other research studies have used hounds to tree or bay mountain lions for research purposes, with mortality ranging from 0-8% and averaging 4% (Hornocker 1970, Anderson *et al.* 1992, Ross and Jalkotzy 1992, Logan *et al.* 1999, Logan 2015).

WS-Colorado achieves much lower injury and death rates during the use of hounds. WS-Colorado uses hounds to capture mountain lions and black bears to alleviate depredations on livestock and wild ungulates of management concern (*e.g.*, mule deer). The three WS-Colorado field specialists using hounds to capture mountain lions have captured approximately 1,600 mountain lions, with the accidental death of only 8 mountain lions (< 0.01%) while working for WS-Colorado or guiding sport hunters (when not employed by WS-Colorado). Their combined experience exceeds 90 years. One of the reasons for the low injury and death rates is that WS-Colorado employees use hound breeds (and other dog breeds) which have been selected for a lack of aggression. Aggressive dogs are removed from the pack to reduce the likelihood of injury to target wildlife, and to the hounds. These hounds are valued at $2000 - $6,500 each; thus, death or injuries to the dogs from fighting with lions or bears would be costly. Also, aggressive dogs are disruptive to the pack, and incur additional veterinary costs. Another reason for our low injury and death rates is that hounds used by WS-Colorado are equipped with GPS radio collars, which allows employees to quickly locate treed lions or bears. This also helps to reduce the likelihood of injury to wildlife and hounds. These and other measures used by WS-Colorado during the use of hounds result in humane capture in the vast majority of cases. Bryce *et al.* (2017) determined that being chased by hounds is energetically costly to mountain lions; however, WS-Colorado generally only chases target animals once, so the energetic costs are unlikely to manifest in any suffering or loss of fitness by the individual.

Ethics of an Action: When evaluating issues relating to the ethics of conserving or controlling nature, another approach is to consider the reason for the action as the determination of whether the action is ethical or not. In this approach, one model involves assessing actions from the point of view of humans only (anthropocentric) or from a more general view of all living organisms (biocentric) that considers any harm to living creatures that can be avoided as immoral (Haider and Jax 2007). These approaches have been considered for conservation decisions, but could also be applied to PDM decisions such as those discussed in this EA.

A simple model for determining the ethics of a potential action proposes assessing whether the action is necessary, and whether it is justified. In this model, if "yes" is the answer to both questions, the action is ethical (Littin and Mellor 2005). Although the considerations relating to each of these questions may involve several factors, only the two basic questions need to ultimately be answered using this model.

Yet another approach developed a set of six major criteria that can be used to design a pest control program that is ethically sound (Littin *et al.* 2004). The six major criteria are:

1) The goals, benefits, and impacts of action must be clear.
2) The action should only be taken if goals can be achieved.
3) The most effective methods must be used to achieve goals.
4) The methods must be used in the best ways possible.
5) The goals must be assessed.
6) Once goals are achieved, processes should be in place to maintain results.

Using this model, an ideal project is one that follows all six criteria above (a "gold standard" project). If not all can be followed, an ethically sound pest control program can still be conducted if the project is conducted in a way that moves toward to the "gold standard". With unlimited funding and time available, achieving a "gold standard" project may be possible. The challenge in coping with this type of model is how to achieve the best project (as close to the "gold standard" as possible) with the least amount of animal suffering within the constraints imposed by current technology and funding. The need for action is established in Chapter 1 of this EA. There are individuals who contest that the need for action is of sufficient scale to warrant management; however, state and federal agencies and elected representatives, have, through promulgation of regulations which permit the actions proposed in this alternative and allocation of funding to PDM, determined that there is sufficient need for action. Project objectives are established through consultation with cooperators. The impacts are analyzed in this EA in a general sense; specifics effects of individual actions are considered by WS-Colorado employees through the use of the WS Decision model to select methods that are effective and appropriate for the given location. WS-Colorado personnel are trained in the safe and effective use of PDM methods and the integrated PDM strategy. The WS Decision model would be used to maximize program efficacy while also minimizing risk of adverse environmental effects. The WS Decision model includes project monitoring and ongoing revision of management actions as needed throughout the process. All WS-Colorado activities include consultation with cooperators on short-term strategies to address the problem and long-term approaches to reduce or eliminate the risk of recurring problems.

Based on this information, the WS-Colorado PDM program meets the six "Gold Standard" criteria of Littin *et al.* (2004), and is considered ethically sound.

The issue of ethics is evolving over time (Perry and Perry 2008). WS has numerous policies, directives, and protective measures that provide direction to staff reinforcing the achievement of the most appropriate and effective PDM program possible. Many of these guidance documents incorporate aspects of the ethical considerations discussed above. Directives pertaining to APHIS-WS activities are located on the APHIS-WS home page @ http://www.aphis.usda.gov/wildlifedamage.

3.6.1.2 Impact of PDM on Private Hunting Opportunities, and Recreational and Commercial Fur Harvest.

Another issue that was discussed was the purported impact that PDM would have on sportsmen. Game and non-game wildlife populations are not significantly impacted by WS PDM take, allowing hunters ample opportunities for pursuit during seasons set by CPW. Recreational trapping of predators with foot-hold traps and snares was banned in Colorado by the passage of Amendment 14. WS PDM is highly directed to target individuals and species in a given area, mostly on private lands, and can be conducted in low to high density predator areas. Typically, WS works on a property until damage is controlled. This can take longer than sportsmen would tend to stay or be allowed to legally harvest in a given area. Additionally, WS only conducts PDM in a small portion of Colorado (usually less than 1% of the State). Private fur harvesters tend to hunt where furbearer populations are high. When the only monetary benefit is fur value, they cannot make a profit by pursuing individual depredating coyotes in local areas where numbers are low. In addition, furs are only prime in the winter months and are not of value at other times of year when PDM is frequently needed. The typical strategy of private fur takers is to hunt the more easily lured animals in a population, which tend to be the younger and less experienced animals, and then move on to other areas. With coyotes, older individuals are the most prone to being livestock and wild ungulate killers (Connolly *et al.* 1976, Gese and Grothe 1995). Thus, offending animals would not likely be removed by private fur takers, which means depredation losses would often be about as severe as they would without private fur harvest. This issue remains basically the same under all of the alternatives.

There may be a marginal decrease in recreational coyote hunting opportunities. This decrease would be marginal because take by WS-Colorado was only 4% of sportsman harvest of coyotes in FY12-16, and we expect similar percentages under Alternative 1. Moreover, most coyote take by WS-Colorado (79% in FY12-16) is on private land, where the landowners generally value livestock protection over coyote hunting opportunities. And even on public lands, livestock owners would likely be inclined to manage predation by coyotes regardless of the Alternative chosen. This Alternative may also result in a marginal decrease in recreational fox hunting opportunities (red fox, gray fox, and swift fox). This impact is expected to be minimal because WS-Colorado takes a very small fraction of the number of foxes taken by sportsmen. Alternative 1 may also result in a miniscule decrease in the number of bobcats which could be taken by sportsmen. This effect would be miniscule, because WS-Colorado take was less than

0.1% of sportsman harvest in FY12-16, and we do not expect that percentage to change significantly. See Section 3.1.1 for a detailed analysis of the impacts to these target predator species.

3.6.1.3 American Indian and Cultural Resource Concerns.

The National Historic Preservation Act of 1966, as amended, requires federal agencies to evaluate the effects of any federal undertaking on cultural resources and determine whether they have concerns for cultural properties in areas of these federal undertakings. In most cases, WDM activities have little potential to cause adversely affects to sensitive historical and cultural resources. If an individual PDM activity with the potential historic resources is planned under an alternative selected as a result of a decision on this EA, then site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

The Native American Graves and Repatriation Act of 1990 provides protection of Native American burials and establishes procedures for notifying Tribes of any new discoveries. Senate Bill 61, signed in 1992, sets similar requirements for burial protection and Tribal notification with respect to Native American burials discovered on state and private lands. If a burial site is located by a WS-Colorado employee, the appropriate Tribe or official would be notified. PDM activities will only be conducted at the request of a Tribe or their lessee and, therefore, the Tribe should have ample opportunity to discuss cultural and archeological concerns with WS-Colorado. However, in consideration of Colorado's Native Americans, WS-Colorado has included all of the recognized Tribes in Colorado on the mailing list for this EA to solicit their comments.

3.6.1.4 Summary of Impacts to Other Sociocultural Issues.

Based on the analyses above, there would be no significant impact to other sociocultural issues under Alternative 1.

3.6.2 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS Colorado would not conduct preventive PDM. Because WS-Colorado only uses preventive PDM for coyotes in certain circumstances (see Section 3.1.2 for example), coyote take by WS-Colorado would decrease under this alternative, whereas the take of all other predator species would remain the same. Some increased PDM by CPW, CDA, and private individuals/entities would likely occur, but overall take of coyotes for PDM would be lower under this Alternative. Indirect impacts would include less selective, less effective, and less humane PDM methods used by private entities. These would all result in less humane treatment of animals than under Alternative 1. Also, livestock losses would be higher, as well as the pain and suffering which goes along with animals being killed by predators.

The amount of suffering by target and non-target wildlife under this alternative would initially be less than under Alternative 1 because fewer animals would be taken by WS-Colorado. However, private individuals would increase their use of foot-hold traps, snares, and shooting for preventive control activities. However, private individuals would not be allowed to use some methods on public lands. Private aerial PDM under this Alternative may increase, but it would be unlikely to increase to levels similar to Alternative 1, because it is not allowed on public lands by private individuals. Lack of preventive predation management with aerial PDM may also result in increases in WS-Colorado's use of traps and snares for corrective PDM, and associated risks to non-target species. Suffering of livestock because of injuries caused by predation would likely increase under this alternative because PDM actions by WS-Colorado could not be implemented until after the onset of depredation.

Alternative 2 would likely be unacceptable to many animal rights advocates and other individuals because it permits lethal removal of predators and because of the risks associated with likely increases in use of traps and snares.

Due to the increases in pain and suffering of target and non-target animals, we conclude that Alternative 2 would not be an improvement over Alternative 1 in regards to these sociocultural issues.

3.6.3 Alternative 3 - WS-Colorado Provides Technical Assistance Only.

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS-Colorado would not conduct any direct PDM, so there would be no direct impacts by WS-Colorado. However, CPW, CDA, and private individuals/entities would likely conduct some increased level of PDM, so indirect impacts would be higher. The indirect and cumulative impacts of this Alternative would be similar to Alternative 4.

Under this alternative, WS-Colorado would provide only technical assistance to people who request assistance with predator damage. This includes verbal or written consultation on alleviating predator damage in a variety of manners, such as animal husbandry, animal behavior modification, and habitat management, lethal and non-lethal tools. However it would be up to the person receiving the information to choose a strategy and implement it. Many private individuals experiencing resource losses, who are no longer provided operational assistance from WS-Colorado, would conduct lethal PDM on their own without receiving technical assistance from WS-Colorado. This would likely increase the pain and suffering to target and non-target species due to the use of less selective, less effective, and less humane methods. Use of foot-hold traps, snares, and shooting by private individuals would likely increase under this alternative. This would result in less experienced persons implementing PDM methods, such as traps, without modifications like the pan-tension devices which exclude smaller non-target animals, or not using modern traps which meet BMP humaneness standards. Greater take and suffering of non-target wildlife would be likely also. It is also possible that frustration caused by the inability of resource owners to reduce losses could lead to the use of illegal toxicants. The illegal use of toxicants would result in increased animal suffering.

PDM actions taken by individuals would probably be less humane than when implemented by WS-Colorado in Alternative 1 for other reasons. WS-Colorado is accountable to public input, and interest groups often focus their attention and opposition to PDM activities employed by WS-Colorado. PDM methods used by private individuals would be more clandestine. The people who perceive some PDM methods as inhumane would be less aware of PDM activities being conducted by private individuals mostly because the private individuals would not be required to provide information under any policies or regulations similar to those followed by WS-Colorado. Thus, the perception of inhumane activities would probably be reduced, although the actual occurrence of inhumane activities would likely increase.

Under this alternative, predation rates would be expected to increase above the current level. Therefore, more domestic animals, including livestock and pets, would suffer inhumanely from injuries caused by predators than under Alternative 1.

This alternative would likely result in more negative impacts with regard to humaneness than the current program. This is primarily due to the fact that more private individuals would attempt to alleviate predator damage without professional training and guidance, and more domestic animals and pets would be killed or injured by predators.

This alternative may be more acceptable to animal rights activists and to a wider range of animal welfare advocates because WS-Colorado would not be operationally involved in PDM. However, this perception may be based on incomplete information because the public, agencies, and tribes would no longer have access to data on the full magnitude of PDM actions in the state. Use of lethal methods would continue, but agencies and tribes would have less information to use to monitor cumulative impacts on target and non-target species populations and ecosystems.

Due to the increases in pain and suffering of target and non-target animals, we conclude that Alternative 3 would not be an improvement over Alternative 1 in regards to these sociocultural issues.

3.6.4 Alternative 4 – No PDM by WS-Colorado.

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Colorado would not conduct PDM, and methods viewed by some persons as inhumane would not be used by WS-Colorado. Thus, there would be no direct effect from the program on humaneness or any other sociocultural issue. However, as for Alternative 3 above (Section 3.6.3), CPW, CDA, and private individuals/entities would likely conduct some increased level of PDM, and associated indirect impacts would be higher. Cumulatively, these indirect impacts on sociocultural issues would likely exceed the impacts under Alternative 1 due to less training and experience, and fewer available PDM methods, such as aerial PDM and M-44s. Livestock losses would increase as discussed under Alternative 3. The net result of Alternative 4 would be very similar to that under Alternative 3. The only difference would be a slight increase in the pain and suffering of animals, due to the lack of a WS-Colorado technical assistance program which would otherwise recommend more humane methods in some cases.

Individuals who would conduct PDM in the absence of a WS-Colorado program would likely have less training, and would not have access to certain PDM methods and applications which would mean the use of less effective or selective methods. In the case of private individuals, accountability, records maintenance, regulatory and policy compliance, and coordination with other agencies may not be required or adhered to the same extent that WS-Colorado is required.

Assuming some aspects of PDM for black bears or mountain lions would be responded to by CPW, there would be no change in humaneness. Private individuals would no longer receive training from WS-Colorado, nor would federal research efforts focused on improved humaneness, selectivity, and nonlethal methods be implemented into PDM in Colorado. Private individuals experiencing resource losses, who are no longer provided professional assistance from WS-Colorado, could conduct lethal PDM on their own. This could have the potential for increased and unnecessary pain and suffering to target and non-target species. Use of foot-hold traps, snares, and shooting by private individuals would probably increase. This could result in less experienced persons implementing PDM methods, such as traps, without modifications like the under pan-tension device that excludes smaller non-target animals. Greater take and suffering of non-target wildlife could result. It is hypothetically possible that frustration caused by the inability of resource owners to reduce losses could lead to illegal use of toxicants. The illegal use of toxicants might result in increased animal suffering.

PDM actions taken by individuals would probably be less humane than with the federal program in Alternative 1 for other reasons. WS-Colorado is accountable to public input, and interest groups often focus their attention and opposition to PDM activities employed by WS-Colorado. PDM methods used by private individuals may be clandestine. The people that perceive some PDM methods as inhumane would be less aware of PDM activities being conducted by private individuals, mostly because the private individuals would not be required to provide information under any policies or regulations similar to those followed by WS-Colorado. Thus, the perception of inhumane activities would probably be reduced, but only due to lack of awareness.

Under this alternative, predation rates would be expected to increase above the current level. Therefore, more domestic animals, including livestock and pets, would suffer inhumanely from injuries caused by predators than under the current program.

This alternative may be more acceptable to some animal rights activists, and to a wider range of animal welfare interests, but this would be based on incomplete information. The public, agencies, and tribes would no longer have access to data on the full magnitude of PDM actions in the state. Use of lethal methods would continue, but agencies and tribes would have less information to use to monitor cumulative impacts on target and non-target species populations and ecosystems.

PDM methods used by private individuals would be more clandestine. Members of the public that perceive some PDM methods as inhumane would be less aware of PDM activities being conducted by private individuals, because private individuals would not be required to provide information under mandatory policies or regulations similar to those applied to WS-Colorado. Thus, the perception of inhumane activities might be reduced, but the actual occurrence of inhumane activities would likely increase.

Due to the increases in pain and suffering of target and non-target animals, we conclude that Alternative 4 would likely result in an increase in negative consequences compared to Alternative 1 in regards to these sociocultural issues.

3.7 Evaluation of Alternatives to Meet the Goals and Objectives of APHIS-WS and WS-Colorado

Several of the goals and objectives of APHIS-WS and WS-Colorado are pertinent to PDM. These goals and objectives have been cited throughout this EA, and they are important to the decision-making process herein. The chosen Alternative ("Preferred Alternative") should be that which best accomplishes these goals and objectives, and minimizes any negative environmental impacts. These goals and objectives are summarized in Table 3-23, with the likelihood that each of the four Alternatives analyzed in detail would be likely to accomplish them. This table answers the question: *would the alternatives achieve the goals and objectives of APHIS-Wildlife Services and Wildlife Services-Colorado?* The answer is either "Yes", "No", or "Somewhat". "Somewhat" is used if the Alternative would partially accomplish the particular goal or objective, but not as effectively as another one of the Alternatives.

3.7.1 Alternative 1 - Continue the Current Federal PDM Program.

Under Alternative 1, all of the relevant goals and objectives of APHIS-WS and WS-Colorado discussed in this EA would likely be effectively achieved (Table 3-23). The achievement of some of these goals is dependent upon the specific performance of the WS-Colorado PDM program in the future, so we cannot say with certainty that they *will* be accomplished. However, this Alternative would provide for the ability to accomplish these goals and objectives. The current WS-Colorado PDM program has been designed to accomplish these goals and objectives, so it is not surprising that our analysis shows that it is capable of accomplishing them.

3.7.2 Alternative 2 - Lethal PDM Methods Used by WS-Colorado Only for Corrective Control.

Under Alternative 2, WS-Colorado would be able to provide for the safety of personnel, and would be able to respond to all losses and threats due to predators. However, WS-Colorado would be limited in our ability to respond in a timely manner to all requests for assistance. For all species other than coyotes, we would be able to respond in a timely manner. But for areas where coyotes have caused historic damage, and preventive PDM would be warranted, WS-Colorado would not be able to respond appropriately to such requests. Thus, we would only be "somewhat" able to achieve this objective.

Table 3-23. Would the four Alternatives considered in detail in this Environmental Assessment (EA) be likely to achieve the goals and objectives of APHIS-Wildlife Services and Wildlife Services-Colorado, as described in this Environmental Assessment?

Goals and Objectives	Alternative 1 Continue WS-Colorado PDM Program	Alternative 2 WS-Colorado Lethal PDM for Corrective Only	Alternative 3 WS-Colorado Provides Technical Assistance Only	Alternative 4 No WS-Colorado PDM Program
Provide for Personnel Safety	Yes	Yes	Yes	Yes
Respond to All Reported Losses or Threats	Yes	Yes	Somewhat	No
Respond to Requests for Assistance in a Timely Manner	Yes	Somewhat	Somewhat	No
Resolve Predator Damage Problems	Yes	Somewhat	Somewhat	No
Manage Predator Risks to Human and Pet Health and Safety	Yes	Yes	Somewhat	No
Manage Predator Damage and Threats to Agriculture	Yes	Somewhat	Somewhat	No
Manage Predator Damage and Threats to Natural Resources	Yes	Yes	Somewhat	No
Reduce Risk of Wildlife Strike Hazards to Aircraft	Yes	Yes	Somewhat	No
Prevent Predator Damage When Feasible	Yes	No	No	No
Minimize Non-target Take	Yes	Yes	Somewhat	No

We would also only be somewhat able to appropriately resolve predator damage problems, because in those cases where preventive coyote PDM would be warranted, we would not take action until damage had occurred. This would result in increased damage to livestock in such cases due to the delay in action. The coyotes most likely to kill sheep are the ones raising pups (Till and Knowlton 1983), and aerial PDM of coyotes on sheep summering grounds removes coyotes that otherwise would likely have produced pups (Gantz 1990). By conducting preventive PDM in late winter, the likelihood of transient coyotes re-occupying vacated territories and establishing new territories in time to produce pups is greatly reduced. Gantz (1990) concluded that late winter aerial PDM of coyotes on summer sheep range was an effective method to reduce coyote predation. Aerial PDM is the tool most often used by WS-Colorado for preventing PDM. Under Alternative 2, aerial PDM could be used later in the season, after damage had been confirmed, but it would not be as effective, or even useful, at that time of year. In the late spring and summer, after damage has already occurred in such areas, the temperatures would be higher, which makes low altitude flying more dangerous. Rather than accepting the additional risk to employees, WS-Colorado would forego aerial PDM in such conditions. And even when the conditions were less dangerous, the leaves on trees and shrubs would obscure the view, making it much more difficult to locate and remove the offending coyotes. As such, WS-Colorado would likely use other methods more heavily, in an effort to make up for these losses. These methods would be less effective, and might be more logistically difficult due to accessibility issues. The end result would be increased predator damage to livestock and increased costs to livestock producers (Wagner 1997, Wagner and Conover 1999).

Additionally, by restricting corrective PDM to the immediate vicinity of predation losses, WS-Colorado would be unable to effectively resolve some depredation problems. Till (1992), found that depredating coyotes traveled an average of 2 miles and as far as 6 miles from their den site to the sheep flocks where they were killing lambs. This would result in further increases in predator damage to livestock.

Under this Alternative, WS-Colorado would be able to effectively manage predator threats to human and pet health and safety and aviation safety. However, we would not be able to effectively manage predator threats to natural resources, because these actions are generally preventive in nature (Rayl *et al.* 2015). WS-Colorado would be able to effectively minimize non-target take, although a slight increase in non-target take would be likely due to the higher use of less selective methods than aerial PDM, which is extremely selective.

3.7.3 Alternative 3 - WS-Colorado Provides Technical Assistance Only.

Under Alternative 3, WS-Colorado would be able to provide for the safety of personnel. The number of WS-Colorado personnel would likely be lower, and the work would include much less field work, but this would not affect our ability to maintain a robust employee safety program.

WS-Colorado would not be able to respond adequately to all losses and threats due to predators under this Alternative. The limited scope of predator work would result in a much smaller workforce (cooperators currently provide most of the funding for WS-Colorado PDM), which would not be able to respond to requests in remote areas, where livestock losses generally occur. We would be able to respond by telephone and via workshops, but the inability to observe and verify losses in the field would limit the effectiveness of these responses. For example, under the current WS-Colorado PDM program, WS Specialists routinely inspect killed livestock to determine whether the damage was caused by predators and what predator caused the damage. We would be extremely limited in our ability to perform this response under Alternative 3. We would also not be able to respond to all predator damage requests in a timely manner. For requests which require inspection of livestock kills, for example, the inspections would either be delayed or not conducted at all due to limited personnel.

WS-Colorado would be limited in our ability to resolve predator damage problems under Alternative 3. Under this Alternative, WS-Colorado would be limited in our ability to effectively manage predator threats to: (1) human and pet health and safety, (2) agriculture, (3) natural resources, and (4) aviation safety. We would still be able to have some level of effectiveness by providing technical assistance, but the lack of an operational program would severely limit our effectiveness in these areas.

Non-target take by WS-Colorado would be minimized under this Alternative, but a moderate increase in non-target take would be likely due to the increased PDM conducted by less experienced, and in some cases less professional persons or entities. WS-Colorado would likely be able to limit some of this non-target take by providing technical assistance, but not all of it. Private individuals and entities would likely conduct some aerial PDM, but this would not likely reach the level currently conducted by WS-Colorado, partly because they cannot conduct aerial PDM on public lands. These private entities would be more likely to use other methods, which are less selective than aerial PDM, as discussed for Alternative 2. This would also increase non-target take. The increased levels of non-target take under Alternative 3 would not likely result in significant negative impacts on non-target species populations, but they would be higher than under Alternative 1.

3.7.4 Alternative 4 – No PDM by WS-Colorado.

Under Alternative 4, WS-Colorado would be able to provide for the safety of personnel. The number of WS-Colorado personnel would likely be much lower, and the work would include much less field work, but this would not affect our ability to maintain a robust employee safety program.

Under this Alternative, WS-Colorado would not be able to respond to losses or threats due to predators. We would also not be able to resolve predator damage problems, including threats to: (1) human and pet health and safety, (2) agriculture, (3) natural resources, and (4) aviation safety. Furthermore, livestock producers who graze on state or federal public lands would be unable to receive PDM assistance in most cases, which would lead to increased livestock losses.

WS-Colorado would not take any non-target species under this Alternative, but a moderate increase in non-target take would be likely due to the increased PDM conducted by less experienced, and in some cases less professional persons or entities. WS-Colorado would not be able to limit this non-target take by providing technical assistance. The quality of technical assistance available to producers would be greatly diminished, because state and federal agencies, and private nuisance wildlife control companies have limited knowledge about predator damage and PDM. Private individuals and entities would likely conduct some aerial PDM, but this would not likely reach the level currently conducted by WS-Colorado, partly because they cannot conduct aerial PDM on public lands. These private entities would be more likely to use other methods, which are less selective than aerial PDM, as discussed for Alternative 2. This would also increase non-target take. The levels of non-target take under this alternative would not likely result in significant negative impacts on non-target species populations, but they would be higher than under Alternative 1, and WS-Colorado would not be able to achieve our goal of minimizing non-target take.

3.8 SUMMARY AND CONCLUSION

Under Alternatives 1 and 2, there would be no significant negative direct, indirect, or cumulative impacts on the issues analyzed in this EA: target predator species populations, non-target species populations, ecosystem function, human and pet health and safety, the use of public lands, and other sociocultural issues.

Under Alternatives 3 and 4, there would be no significant negative direct, indirect, or cumulative impacts on target species populations, non-target species populations, ecosystem function, the use of public lands, or other sociocultural issues. However, under Alternatives 3 and 4, there would likely be major negative impacts to human and pet health and safety due to increased non-target capture; increased use of more dangerous methods by less experienced personnel; the increased risk of mountain lions, black bears, and coyotes attacking people and pets; and the increased risk of accidents from aerial PDM.

Differences would occur among the alternatives regarding the amount of target predator take and non-target take, but those differences would not result in significant impacts to the statewide populations of any of the species analyzed in this EA, under any of the Alternatives. This includes the likely direct, indirect, and cumulative impacts under each Alternative.

From an environmental impact perspective, Alternatives 1 and 2 would both be acceptable. From an economic impact perspective, only Alternative 1 is acceptable, because livestock losses would be increased under the other three Alternatives. From a societal perspective, each of the Alternatives would be acceptable, depending on an individual's values, attitudes, and beliefs. From a natural resource management perspective, only Alternative 1 would reverse declines in native wildlife species populations due to predation.

Alternative 1, the continuation of the current WS-Colorado PDM program, is the Alternative which best accomplishes the goals and objectives of APHIS-WS and WS-Colorado. And it is the only Alternative which is likely to accomplish them all. It is therefore the Preferred Alternative based on the analyses in this EA.

Under Alternative 1, past, present, and reasonably foreseeable future actions would not result in cumulatively significant negative environmental impacts on any of the issues analyzed in detail in this EA: target predator species populations, non-target species populations, ecosystem function, human and pet health and safety, the use of public lands, and other sociocultural issues. These actions would also result in no cumulative negative impacts on any of the other issues considered, but not in detail (Section 2.3). All WS-Colorado PDM activities under this Alternative will comply with relevant laws, regulations, policies, orders, and procedures (including the ESA, MBTA, and FIFRA). When finalized, this EA will remain valid until WS and other appropriate agencies determine that new actions or new alternatives, having substantially different environmental effects, must be analyzed; or until changes in environmental policies, the scope of the WS-Colorado PDM Program, or other issues trigger the need for additional NEPA analysis. This EA will be reviewed periodically for its continued validity, including regular monitoring of the impacts of WS-Colorado PDM activities on populations of both target and non-target species, and will be updated as needed.

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CHAPTER 5. PUBLIC COMMENTS AND RESPONSES

We received 540 comment letters, with a total of 2,912 individual comments. Many of these comments were identical or substantially similar. Below, we have summarized these comments. Whenever possible, we have combined similar comments together, and provided a single response which covers the breadth of those comments. All of the comments we received were either outside the scope of the EA, were adequately addressed in the Draft EA, or have been addressed more clearly in this Final EA. The vast majority of these comments were adequately addressed in the Draft EA. In the interest of transparency, we have responded to all comments, and we provide all of these comments and responses below.

Below, comments are provided in **bold**, and our response is provided below the comment in normal font (*i.e.*, not bold).

5.1 Outside the Scope of the EA.

We received numerous comments which are categorically outside the scope of the EA. Comments on topics outside the scope of the EA include hunting, disease management including Chronic Wasting Disease, lethal wolf management, listing of threatened or endangered species, introducing wildlife species, providing habitat for wildlife, and other land management decisions

This EA covers PDM conducted by WS-Colorado within the State of Colorado, as stated in Sections 1.2, 1.15.4, and 1.16.2. All other wildlife management actions, especially those conducted by other agencies, are outside the scope of the EA. This includes the following list of comments, which are outside the scope of this EA:

- Colorado's wildlife managers are corrupt.
- CPW should not base bear hunting quotas on human-bear conflicts; Heather Johnson's research shows there is no link. Doing so will cause a significant decline in the black bear population.
- Is opposed to the composition of the Colorado Wildlife Commission.
- Chronic Wasting Disease (CWD) is spreading, despite attempts to manage it.
- CWD results from overpopulation of ungulates
- The existence of wolves decreases prevalence of tick-borne diseases in humans because they eat rodents and deer. This includes Lyme, Babesia, Bartonella, Anaplasmosis, Erlichiosis, Powassan Virus.
- The Montana CWD management plan will not be effective, based on Wild *et al.* 2011 and the experiences in Wisconsin.
- Wolves contribute to habitat for animals including cattle, according to a CU study.
- An EIS should be prepared to determine the cause of the declining deer population.
- An EIS should be prepared to establish a scientific basis for what research will be conducted on mule deer population dynamics.
- Coyotes are overpopulated in Colorado due to the extirpation of wolves.
- The presence of wolves will increase ungulate numbers.
- Wolves should not be delisted.
- Wolves should not be delisted in Wisconsin.
- Wolves should be reintroduced into Colorado.
- More land is needed for wildlife habitat.
- Remote lands should be protected for wildlife habitat.
- WS-Colorado should provide more habitat for wildlife.
- Is opposed to grouse hunting.
- Is opposed to hunting.

- Is opposed to increased hunting of predators.
- Is opposed to increased mountain lion hunting.
- Is opposed to increased predator hunting.
- Is opposed to trophy hunting.
- Mountain lions are hunted in excessive numbers with poor regulations, and poor population information in most states, including Colorado.
- Humans cause ecological damage.
- Hunting results in social chaos in mountain lion communities, which results in increased conflicts with humans, pets, and livestock, according to Peebles *et al.* (2013) and Teichman *et al.* (2016).
- The endangered species act is important.
- Is opposed to catering to hunters.
- Is opposed to fossil fuel extraction.
- Is opposed to killing of prairie dogs
- Is opposed to real estate development.
- Opposes the ranching profession.
- Wolves are essential.
- There are few wolves left in the United States.
- Wolves control ungulate populations, and that food availability regulates wolf populations.
- Climate change is having a negative impact on predator populations in Colorado.

5.2 Supportive Comments.

We received several supportive comments, or comments with which we agree.

The following comments are generally supportive of the content and analyses in the EA, or provide statements with which we categorically agree. We appreciate these comments. These include:

- Agrees with the use of PDM, including lethal PDM, for coyotes and feral cats in particular.
- Generally agrees with the information, analyses, and determinations in the EA, which are sound.
- Supports the Preferred Alternative (Alternative 1).
- The EA is generally thorough and reasonable.
- CDA is statutorily mandated to control depredating animals in Colorado in order to reduce economic losses to agricultural products and resources.
- Appreciates that WS-Colorado will promote consideration of ecosystem services.
- CPW ultimately decides whether to conduct the predator removal research.
- The EA is thorough and detailed.
- Agricultural losses would be much higher without WS-Colorado's PDM Program.
- The need for PDM to protect livestock is considerable; livestock losses exceed $300,000 per year in Colorado.

5.3 Purpose, Goals, and Objectives.

We received several comments regarding the purpose, goals, and objectives of the EA, the Preferred Alternative (Alternative 1), APHIS-WS, WS-Colorado, or PDM in general. Several of these comments assert or imply that these purposes, goals, or objectives are to extirpate predator species, control animal populations, decrease predator populations, or to increase hunting revenue.

The assertions and implications in these comments are false, and do not represent the purpose, goals, or objectives of the EA, Alternative 1, WS-Colorado, or APHIS-WS. The purpose of the EA, and the goals and objective of APHIS-WS and WS-Colorado were discussed in Sections 1.2, 1.9, 1.11, and 1.11.2.

As discussed in Section 1.11.2, one of WS-Colorado's objectives is to "[i]mplement PDM so that cumulative effects do not negatively affect the viability of any native predator populations." The analyses in Sections 3.1.1, 3.2.1, and 3.3.1 indicate that WS-Colorado actions under Alternative 1 would accomplish this objective. These analyses indicate that there would be no significant cumulative impact to native predator populations, or any other native wildlife species' population, in Colorado under Alternative 1. No native predator species will be extirpated under Alternative 1. It is unclear how the commenter believes that the purpose of the EA is to increase hunting revenue; WS-Colorado has no authority over hunting laws and regulations, does not sell hunting licenses and receives no funding from hunting activities. We assume that this comment is directed at CPW, which has authority over legal hunting in Colorado.

5.4 M-44 Devices.

We received several comments regarding the use of M-44 devices and other poisonous chemicals. These comments assert that the use of M-44 devices and other poisonous chemicals under Alternative 1 would result in significant impacts on human safety, pet safety, non-targets, threatened and endangered species, public lands, and wilderness areas. Several comments also asserted that M-44 devices are indiscriminate and inhumane, and that they pose secondary hazards to non-targets, as well as potentially contaminate groundwater under Alternative 1.

WS-Colorado might use two chemicals for lethal PDM, as discussed in Section 3.2.1: sodium cyanide, the active ingredient in M-44 devices, and carbon monoxide, the active chemical released by Large Gas Cartridges. We disagree with the assertions that M-44 devices and Large Gas Cartridges pose a significant hazard to people, pets, non-targets, threatened and endangered species, public lands recreation, or wilderness areas under Alternative 1. We also disagree that M-44 devices are indiscriminate, inhumane, and that they would pose secondary hazards or contaminate groundwater under Alternative 1. These methods are discussed in detail in Appendix A. Section 3.4.1 also cites the risk analyses conducted by APHIS-WS on the use of these methods (WS 2017i and 2017j). We analyzed the potential for M-44s and Large Gas Cartridges to negatively impact these environmental aspects in Sections 3.2.1, 3.4.1, 3.5.1, and 3.6.1. Alternative 1, including the use of M-44s and Large Gas Cartridges, was determined to result in no significant impacts on any of these environmental issues in these Sections. M-44s and Large Gas Cartridges are safe and selective when used properly, and according to the EPA labels, as discussed in Appendix A.

M-44 devices and Large Gas Cartridges are highly selective for target species when used properly, as discussed in Section 3.4.1, the APHIS-WS risk analyses (WS 2017i and 2017j) included by reference in this Section, and in Appendix A. Information on the limitations on the use of M-44s in Colorado, and the practices WS-Colorado uses to minimize the risks of these devices are found in Table 2-4; Sections 1.11.3, 1.18.2.1, 2.10.23, 2.11.2.6, 2.11.2.7, 3.2.1.1, 3.4.1, 3.4.1.4, and 3.5.1; and in Appendix A. This information was used in our analysis and determination in Section 3.2.1, 3.4.1, and 3.4.1.4. Information on the limitations on the use of Large Gas Cartridges by WS-Colorado is included in Section 2.11.2.3. Large Gas Cartridges are used in underground burrows in outdoor settings; this severely limits the potential for exposure of humans or non-target animals.

These risk analyses address secondary exposure risks for each chemical, as discussed in Section 3.2.1. Secondary exposure of predators and scavengers to sodium cyanide, the active ingredient in M-44s, is unlikely, because the chemical is quickly converted to hydrogen cyanide gas upon discharge, which is quickly metabolized in the target animal, as discussed in Section 3.2.1. Secondary exposure of predators or scavengers to carbon monoxide, the effective agent released by Large Gas Cartridges, is unlikely because carbon monoxide dissipates from carcasses rapidly, does not persist in the target organism, and does not bioaccumulate, as discussed in Section 3.2.1. In addition, the carcasses of most target species taken with large gas cartridges remain underground in their burrows where they are inaccessible to scavengers, as discussed in Section 3.2.1.

We understand that some individuals will oppose the use of M-44s and Large Gas Cartridges due to the poisonous chemicals they contain. Section 2.11 provides the protective measures used by WS-Colorado to minimize the likelihood of non-target take or human exposure. These methods are discussed in Section 3.4.1, and in Appendix A. Section 3.4.1 also cites the risk analyses conducted by APHIS-WS on the use of these methods (WS 2017i and 2017j). These risk analyses, which are included by reference in the EA, address threats to non-targets, secondary exposure risks, groundwater contamination risks, and human health risks for each chemical. These risk analyses determined that risks to non-targets, secondary hazards, human health risks, and the potential for groundwater contamination from these chemicals are low, and would not present any significant environmental hazard when used properly, and according the EPA labels. WS-Colorado does not use M-44s on public lands, as noted in Table 2-4; Sections 2.10.23, 2.11.2.6, 2.11.2.7, 3.4.1, 3.4.1.4, and 3.5.1; and in Appendix A. This includes local parks and wilderness areas.

One commenter implied that human and pet exposures to sodium cyanide from the use of M-44 devices is reasonably foreseeable under Alternative 1, based on 12 instances of M-44 exposures to people and pets nationwide since 1994. We disagree with this assertion. Human and pet exposures from the use of M-44s are rare and unpredictable events, and WS-Colorado follows numerous preventive measures, use restrictions, EPA regulations, and APHIS-WS policies to reduce the likelihood of such an occurrence, as discussed in Sections 2.6.6, 2.11, 3.4.1, 3.4.1.4, and Appendix A. These are also included in the APHIS-WS risk analysis (WS 2017i) included in the EA by reference in Section 3.4.1. WS-Colorado uses very few M-44s in Colorado, as discussed in Sections 2.6.11, 2.10.23, and analyzed in Sections 3.4.1 and 3.4.1.4. As stated in these Sections, WS-Colorado took an average of 27 predators per year with M-44s, which is very low compared to total predator take by WS-Colorado (Section 3.4 and 3.4.1.4). This is also very low compared to nationwide APHIS-WS take with M-44s (*i.e.*, 0.2% of 14,321 animals taken nationally; Section 3.4.1.4 and WS 2017i cited in Section 3.4). In the 19 years since the pet exposure in Colorado in 1999 (referred to by the commenter), there have been no exposures to humans or pets in Colorado. In addition, WS-Colorado only uses M-44s on private lands, as stated throughout the EA including Sections 2.11 and 3.4.1.4. This policy markedly reduces the potential for non-target or human exposure, especially in Colorado where public lands recreation is so prevalent (Section 3.4.1.4).

One commenter asserts that we provided less information on M-44 devices in this EA than in the 2017 WS-Colorado PDM EA. We disagree with this assertion. We were less verbose in explaining M-44s because some information was included by reference in the cited literature. Relevant and important information regarding M-44s was included in the EA by reference (*e.g.*, WS 2017i in Section 3.4.1); and in Table 2-4; Sections 1.11.3, 1.18.2.1, 2.10.23, 2.11.2.3, 2.11.2.6, 2.11.2.3, 2.11.2.7, 3.2.1.1, 3.4.1, 3.4.1.4, and 3.5.1; and Appendix A.

5.5 Traps and snares.

We received several comments regarding the use of traps and snares for PDM. These comments assert that the use of traps and snares under Alternative 1 would result in significant impacts on human safety, pet safety, non-targets, threatened and endangered species, public lands, and wilderness areas. Several comments also asserted that traps and snares are indiscriminate and inhumane.

WS-Colorado might use several types of traps under Alternative 1, and discussed in Section 2.6 and Appendix A. We assume that the commenters intend to refer to foothold traps, so this response focuses on foothold traps. However, other types of traps were also covered in the same Sections of this EA, so this response applies to those traps as well.

We disagree with the assertions that use of traps and snares under Alternative 1 would result in significant impacts on human safety, pet safety, non-targets, threatened and endangered species, public lands, and wilderness areas. We also disagree with the assertions that traps and snares are indiscriminate and inhumane. The potential for traps and snares to impact non-target animals, threatened and endangered species, human and pet safety, public lands, and wilderness areas was included in our analyses in 3.2.1, 3.4.1, and 3.5.1. These analyses include the citation of the APHIS-WS risk analysis on the use of foothold traps (WS 2017f). Protective measures for the use of traps and snares by WS-Colorado are included in Section 2.11. Further information on trapping and snaring practices is provided in Appendices A, C, and D. Traps and snares pose little risk to humans, and during the five-year analysis period of the EA (FY12-16), no humans were directly impacted by any traps or snares set by WS-Colorado. During this period, only one domestic dog was captured by all traps and snares combined, which was immediately released on-site and unharmed (Table 3-13, Section 3.2.1).

Much research has been conducted since the 1990's on traps and snares to make them more humane to animals, more efficient at catching wild animals, more effective, more selective at catching target animals and avoiding non-target animals, and lastly to make traps more safe for people. The Best Management Practices for Traps was the international process used by Canada and the United States to improve the animal welfare, efficacy, efficiency, selectivity and safety of traps. Passive snares always were safe for humans. All types of snares are being evaluated also by the Best Management Practices process. This process is discussed in the EA at Section 3.6.2. These improvements have resulted in the replacement of older traps with their many flaws. Unfortunately, archaic laws have locked into place traps and snares (passive, powered, mechanical, foot, and body) that may be used in Colorado due to Amendment 14. Traps have advanced significantly as improvements to use these devices has advanced in leaps and bounds in the last 20 years. The same can be said for snares which are misunderstood by most of the public.

Traps and snares are less selective than other methods, such as aerial PDM, as stated in Sections 3.2.2 and 3.6.2). However, traps and snares can be highly selective when used appropriately by knowledgeable and experienced wildlife professionals, as discussed in Section 2.11, throughout Chapter 3, and in Appendix A. As discussed in Section 2.11, 3.2.1.1, and Appendices A, C, and D, WS-Colorado employs various protective measures to make all methods as selective as possible. WS-Colorado also consulted with the USFWS to minimize the likelihood that the use of traps and snares would impact any threatened or endangered species in Colorado. WS-Colorado non-target take was discussed and analyzed in Section 3.2.1, including non-target take from traps and snares. The minimal amount of non-target take anticipated under Alternative 1 was not determined to result in any significant impact to non-target wildlife, including threatened and endangered species (Sections 3.2.1 and 3.2.1.1).

We discussed humaneness and ethical perspectives of Alternative 1 in Section 3.6.1.1. This discussion includes the use of traps and snares. Protective measures are discussed in Section 2.11. The humaneness of trapping, including trapping BMPs are addressed throughout the EA, including Sections 1.18.2.1, 2.2.6.1, 2.11.2.8, and 3.6.1.1.

Traps and snares play a key role in wildlife management. They are critically important tools for endangered or threatened species recovery, disease management, damage reduction, and research (TWS Northeast Section 2015). When Best Management Practice traps are employed then wildlife conservation programs are conducted in an efficacious and cost effective manner. There are a number of examples where modern traps and snares are used by wildlife managers. Some brief examples include a) removing beaver from streams to allow treatment of invasive non-native fish and allow introduction of native fish, b) removal of non-native and unnaturally abundant mammalian predators (red fox and raccoon) from islands to allow population suppressed shorebirds (plovers, oystercatchers, terns) to recover, c) live-capture and release of raccoons after taking a blood sample to check for rabies titers and vaccination, d) translocation of river otters to recover species to the original range, e) capturing wolves depredating livestock for translocation during species recovery programs, f) capture and removal of coyotes killing new born sheep from lambing grounds, g) capture of coyotes in urban cities killing pets or attacking children and h) capturing coyotes to radio collar and release to learn ecological principles about their demographics. In these instances the animals are captured in foot-hold traps, body snares, box traps, body gripping traps, species specific traps, and mechanical foot snares.

5.6 Hounds.

We received several comments regarding the use of hounds for PDM. These comments assert that the use of hounds under Alternative 1 would result in significant impacts on target species, pet safety, and non-target animals. Several comments also asserted that the use of hounds is inhumane, not fair chase, and would result in trespassing on private lands.

We disagree with the assertions that the use of hounds under Alternative 1 would result in significant impacts on target species, pet safety, and non-target animals. We also disagree with the assertions that that the use of hounds is inhumane, and would result in trespassing on private lands. Fair chase standards apply to legal hunting. They do not apply to PDM or WDM, where the goal is to solve the problem as safely, efficiently, and humanely as practical. We discussed humaneness and ethical perspectives of Alternative 1 in Section 3.6.1.1. This discussion includes the use of hounds. Protective measures are discussed in Section 2.11. To further address concern about non-targets, we added an analysis of the potential for non-target impacts from the use of hounds in Section 3.2.1 of this EA, and cited the research of Grignolio *et al.* (2011) and Mori (2017) in this Section (these research studies were cited by commenters). We found that there would be no significant impact to non-target animals. To further address the concern about mountain lions and bears being attacked by hounds, we added an analysis of the potential impact of the use of hounds on black bears and mountain lions in Sections 3.6.1.1 of this EA, and cited the research of Elbroch *et al.* (2013) and Bryce *et al.* (2017) in this Section (these research studies were cited by commenters). We found that there would be no significant impact to these predator species. To further address the issue of risks to the hounds, we added an analysis to Section 3.4.1.8 of this EA. We found that there would be no significant impact to the hounds. State trespassing laws do not apply to animals, including dogs.

5.7 Alternatives.

We received numerous comments regarding the alternatives considered in the EA. Many of these comments assert that we did not or should have considered various alternatives. Some commenters state their preference for Alternative 3 or Alternative 4, or their support or opposition to Alternative 1. Some comments assert that the alternatives are not adequately described, and one commenter states that the description of Alternative 2 was inconsistent in the EA.

We considered dozens of alternatives in Section 2.10 which comport with the requests of various commenters, including: (1) losses should be accepted as a cost of doing business (Section 2.10.1), (2) no PDM at taxpayer's expense (Section 2.10.2), (3) Use of Only Lethal Methods by WS-Colorado (Section 2.10.4), (4) WS-Colorado verifies that reasonable non-lethal methods are used before implementing or recommending lethal operations (Section 2.10.6), (5) WS-Colorado Verifies that All Possible Non-lethal Methods are Exhausted Before Implementing Lethal Operations (Section 2.10.7), (6) Compensation for losses (Section 2.10.9), (7) the use of sport hunting (Section 2.10.11), (8) translocation of predators (Section 2.10.12), (9) Livestock Producers Pay 100% of WS-Colorado Assistance Involving Lethal Removal (Section 2.10.22), and (10) no PDM on federal lands (Section 2.10.23). These alternatives were not considered in detail for the reasons stated in these Sections.

We did not consider some alternatives which other commenters requested, including "no public lands grazing." These alternatives are outside the jurisdiction of WS-Colorado, and were also determined not to be reasonable alternatives. Some commenters assert that we should have considered these alternatives, based on the CEQ regulations at 40 CFR 1502.14(c), which state that agencies shall include "reasonable alternatives not within the jurisdiction of the lead agency." We disagree with these assertions. WS-Colorado determined that these are not reasonable alternatives, and the cited CEQ regulation states that agencies shall include only "reasonable" alternatives which meet this criterion. WS-Colorado considered all reasonable alternatives in the EA. The alternatives we considered which were outside of our jurisdiction were not analyzed in detail for the reasons provided in the analysis of these alternatives (for example, see Sections 2.10.8, 2.10.9, 2.10.11, 2.10.17, 2.10.20, 2.10.26, and 2.10.27).

We did not consider any alternatives in which we would refuse specific PDM services to anyone or any entity without cause, because they would not be consistent with the fairness standards of USDA, APHIS, or WS. Therefore, such alternatives would not be reasonable alternatives. This includes the proposed alternative of "no use of lethal PDM for participating in studies such as the CPW Plans."

We disagree with the assertions that the EA fails to adequately describe Alternative 1. Alternative 1 is thoroughly described throughout Section 2.6, and Appendix A. The APHIS-WS Decision Model is described in detail in Section 2.6.2, including Figure 2.1. The inclusion of information on how often various method will be used, where each method will be used, and which methods will be used in each situation is not feasible due to the unpredictable and sporadic nature of many predator damage incidents, as discussed in Section 3.1.2 and 3.2.2. The analyses of Alternative 1 in Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, 3.6.1, and 3.7.1 did not rely in any way on the assumption that lethal PDM would likely occur by other entities. We are not aware of any credible information which would refute our analyses in these Sections.

We disagree with the assertion that the EA did not adequately describe Alternatives 2-4. Alternatives 2, 3, and 4 are adequately described in the EA in Sections 2.7, 2.8, 2.9, 3.1.2, 3.1.3, 3.1.4, 3.2.2, 3.2.3, 3.2.4, 3.3.2, 3.3.3, 3.3.4, 3.4.2, 3.4.3, 3.4.4, 3.5.2, 3.5.3, 3.5.4, 3.6.2, 3.7.3, 3.7.4, 3.7.2, 3.7.3, and 3.7.4. The one exception is that the Draft EA contained an incorrect description of Alternative 2 in Section 2.7; this was corrected in Section 2.7 of this Final EA. We thank the commenter for bringing this mistake to our attention. We used the best available information in our analyses in Sections 3.1.2, 3.1.3, 3.1.4, 3.2.2, 3.2.3, 3.2.4, 3.3.2, 3.3.3, 3.3.4, 3.4.2, 3.4.3, 3.4.4, 3.5.2, 3.5.3, 3.5.4, 3.6.2, 3.6.3, 3.6.4, 3.7.2, 3.7.3, and 3.7.4. We are not aware of any credible information which would refute our analyses in these Sections.

We disagree with the assertion that no alternative was analyzed in which lethal PDM would be decreased. Lethal PDM by WS-Colorado would be lower, and lethal PDM would likely be lower overall, in Alternatives 2, 3, and 4, as discussed in Sections 3.1.2, 3.1.3, and 3.1.4.

Many commenters preferred Alternative 4. We analyzed the potential impacts of Alternative 4 in detail in Sections 3.1.4, 3.2.4, 3.3.4, 3.4.4, 3.5.4, 3.6.4, and 3.7.4. This alternative was determined to have "increased risks to human and pet safety" (Section 3.4.4). Under this alternative, WS-Colorado would not be able to meet our goals and objectives (Section 3.7.4). As such, our analysis indicates that Alternative 4 is inferior to Alternative 1.

Some commenters were in favor of Alternative 1 (the Preferred Alternative), and others were opposed to it. WS-Colorado recognizes that some individuals will oppose this Alternative 1. Our analysis shows that this is the only alternative which can accomplish the goals and objectives of APHIS-WS and WS-Colorado (Section 3.7.1). Our analyses also show that this Alternative will not result in any significant impacts on the environment (Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1).

5.8 CPW Predator Research Studies.

We received numerous comments regarding the CPW predator research studies discussed in Section 2.6.9.4. Most of these comments assert that the cause of the statewide mule deer declines is habitat loss or degradation, fossil fuel exploration and extraction, or climate change, and that predation is not impacting deer populations. Consequently, these commenters assert that habitat management will increase deer populations, whereas PDM will not. Many of these commenters claim that the science wholly supports their assertions, and refutes the potential role of predation. Some commenters claim that the CPW research study designs are flawed, inadequate, lacking

crucial information, or violations of law. Others claim that the studies are not in fact studies, but management plans designed to increase hunting opportunities and hunting revenue. Other commenters simply oppose the studies.

Commenters assert that predators control ungulate populations, or, conversely, that predation increases ungulate populations. Still others assert that deer and elk are overpopulated, either statewide, or in specific urban areas. A few commenters assert that more research is needed on this topic.

We disagree with most of these assertions. Our thorough analysis in Sections 1.17.5.1, 1.17.5.2, 1.17.5.3, 1.17.5.4, 1.17.5.5, and 2.6.9.4 includes the best available science, and indicates that this topic is complex, and that habitat changes (including those caused by gas and oil exploration and extraction), predation, weather and other factors might affect ungulate populations. Specific research projects by CPW to assess the influence of predation on mule deer population dynamics are discussed in Section 2.6.9.4, and the CPW Study Plans are provided in Appendices G and H. Some commenters cited Johnson *et al.* (2016) and Anderson (2015) as evidence that energy development is the cause of mule deer declines. We disagree with these interpretations of the research. Johnson *et al.* (2016) showed a correlative link, not necessarily a causative link, between residential and energy development and mule deer demographics. Moreover, these authors do not claim that energy development or residential development are the only driver of mule deer demography, nor that either is responsible for all mule deer declines throughout Colorado. The research conducted by Anderson (2015) is part of the body of research which has led this scientist to examine other potential drivers of mule deer population dynamics, including predation (CPW study plans included in Appendices G and H).

One commenter provided images of the Piceance Basin from 1984 and 2016, and noted that the number of wells and roads in the images is negatively correlated with mule deer populations. These images and scant data are not sufficient evidence to determine the cause of the mule deer declines. We prefer to use scientific data and research for such determinations.

Regarding the assertions that the CPW research studies are flawed, inadequate, lacking information, or violations of law, some commenters cite Ballard *et al.* (2001), Hurley *et al.* (2011), and Pojar and Bowden (2004) to support these assertions. We disagree with these assertions. We believe that the CPW predator research study designs referred to in Section 2.6.9.4, and included in Appendices G and H, are supported by the best available science, that the research study designs are appropriate, and contain adequate information. We are not aware of any potential violations of law from these studies. We analyzed and discussed this topic thoroughly in Sections 1.17.5.1, 1.17.5.2, 1.17.5.3, 1.17.5.4, 1.17.5.5, and 2.6.9.4. The discussion and analysis in Section 2.6.9.4 includes the research of Ballard *et al.* (2001) and Hurley *et al.* (2011); these studies are cited in that Section of the EA. We considered the content of Pojar and Bowden 2004 during the preparation of the EA. It did not add substantively to the information and analysis provided on this subject in Section 2.6.9.4.

We agree that more research is warranted to assess the reasons for mule deer population declines, and on the role of predation on ungulate population dynamics. This topic was thoroughly discussed in Sections 1.17.5 and 2.6.9.4. Specific research projects by CPW to assess the influence of predation on mule deer population dynamics are discussed in Section 2.6.9.4, and the CPW Study Plans are provided in Appendices G and H. We understand that some individuals will not agree with all aspects of the WS-Colorado PDM Program, including our participation in these CPW research projects. We believe that the CPW predator research projects are worthwhile and scientifically valid, as discussed in Section 2.6.9.4 and Appendices G and H. We support such science and research, which will lead to better information on which to make decisions regarding wildlife management.

We disagree that deer are overpopulated in Colorado. CPW data presented in Sections 1.17.5.4 and 3.2.1.4, and in Figure 3-3 show that the statewide mule deer population was below recent highs as of 2016, and well below the CPW's desired population target range of 560,000 (Section 1.17.5.4). The discussions of the CPW predator research studies in Section 2.6.9.4 are based on CPW data which show that deer populations in those specific areas are below nutritional carrying capacity. Urban deer, such as those in Colorado Springs and El Paso County, may be an exception. Urban deer populations in Colorado, and the management of urban deer populations are outside the scope of the EA.

We disagree with the assertion that predators increase ungulate populations. We are not aware of any credible data or research to support this claim, and no commenter provided any credible information to support this claim.

The purpose of both of the two CPW studies referenced in the EA in Section 2.6.9.4 is to conduct primary scientific research on the impact of predation on neonate mule deer survival. The study plans for these research project are provided in Appendices G and H. Assertions that the studies are being conducted for other purposes are false, based on the study plans in Appendices G and H.

We disagree with the assertions that the EA misrepresents current mule deer populations, and ignores the history of mule deer populations in Colorado, according to Broscheid (2016) and Anderson (2015). Anderson (2015) is a CPW Wildlife Research Report. Broscheid (2016) is a letter from CPW Director Bob Broscheid to the Colorado Parks and Wildlife Commission which includes recommendations for numbers of hunting licenses. Both of these documents refer to deer populations. However, the mule deer population data presented in Sections 1.17.5.4, 3.2.1.4, and Figure 3-3 are CPW's official population estimates. These represent the primary documents for mule deer population information (2017a). Broscheid 2016 and Anderson 2015 use these same estimates; these sources do not provide any substantive information regarding mule deer populations in Colorado. Historic mule deer trends are presented in Section 1.18.5.2, as well as in Section 3.2.1.4 and Figure 3-3.

We disagree with the assertion that mule deer in the CPW predator study areas are at or near carrying capacity. CPW data and research suggest that mule deer in these study areas are below carrying capacity, as discussed in Section 2.6.9.4.

One commenter asserts that statewide deer populations are increasing. CPW data provided in Sections 1.17.5.4, 3.2.1.4, and Figure 3-3 show that the estimated mule deer population was 424,190 in 2014, 435,660 in 2015, and 418,560 in 2016 (Sections 1.17.5.4, 3.2.1.4, Figure 3-3; data from CPW 2017a). These numbers represent an increase from 2013 (390,660; Sections 1.17.5.4, 3.2.1.4, Figure 3-3; data from CPW 2017a). This is good news, and suggests that the Colorado mule deer population may be rebounding. However, the data do not show a clear trend of increasing deer populations; the 2016 estimate is lower than either 2014 or 2015. These numbers are also well below CPW's desired population target range of 560,000 (CPW 2017b).

We are not aware of any significant elk population decline, as expressed by some commenters. Analysis of the Colorado elk population is outside the scope of this EA.

5.9 Prey Selection and Diseases of Wildlife.

We received numerous comments on the topics of prey selection among predators, and the potential for prey selection to influence wildlife diseases, including Chronic Wasting Disease (CWD). Commenters assert that various predators select for sick or infected animals, and that this selective predation will result in limiting, reducing, or eliminating CWD and other diseases of wildlife, including zoonotic diseases. Commenters cite Krumm *et al.* 2009, Wild *et al.* 2011, Miller *et al.* 2008, and Hobbs 2006. Some commenters asserts that native carnivores are the best or only way to control or eliminate CWD. One commenter asserts that wolves may reduce the spread of brucellosis by scavenging aborted bison and elk calves, citing Johnson (1992). One commenter cited L. David Mech as a wolf expert, who said that wolves selectively prey on "the old, the young, the sick, and the

weak" and that wolves therefore make prey populations healthier, according to a newspaper article in the Jackson Hole News and Guide by T. Wilkinson.

There is some evidence to support the assertion that mountain lions selectively remove CWD-infected mule deer (Krumm *et al.* 2009, Miller *et al.* 2008). We are not aware of any credible evidence that wolves selectively remove CWD-infected animals, or that either predator species selectively removes prey infected with other diseases, although it is likely that they do to some extent.

To assess the potential for predators to control diseases by selectively preying on sick animals, we added a discussion of prey selection in Section 1.17.5.1. This discussion includes the following references: Krumm *et al.* 2009, Wild *et al.* 2011, and Miller *et al.* 2008. We did not include Hobbs 2006 in this discussion because this is an unpublished report, and the methods and results of this report appear to be included in Wild *et al.* 2011. We also added an analysis of the potential for Alternative 1 to impact diseases of wild prey to Section 3.3.1.3, and an analysis of the potential for Alternative 1 to impact diseases of humans to Section 3.4.1. As discussed in this section, we are aware of no credible evidence to support the assertion that predators decrease disease risk to humans.

We are not aware of any reliable evidence to support the supposition that wolves might decrease the spread of brucellosis, as discussed in Section 3.3.1.3, including assessment of the information in Johnson (1992) and other authors. This Section assesses the potential role of wolves and other native predators to manage diseases of wildlife. Wolves were reintroduced to Yellowstone in 1995. They have been preying on ungulates and scavenging on aborted ungulate calves since then in Yellowstone. To this day, brucellosis is still found in wild elk and bison in Yellowstone.

We considered the statements of L. David Mech, as reported in the Jackson Hole News and Guide newspaper article by T. Wilkinson. Wolves are likely to selectively prey on the old, the young, the sick, and the weak, but this is only part of prey selection, as discussed in Section 1.17.5.1. We are not aware of any credible evidence that wolves make prey populations healthier.

No extant population of wolves is known to exist in Colorado, as noted in Section 3.1.1.1, and the EA does not consider lethal removal of wolves.

One commenter asserted that CWD will decimate ungulates in a few short years. We are not aware of any reliable information which would suggest that ungulate populations will be decimated by CWD, much less within just a few years. This assertion is very unlikely.

According to our analyses in Sections 3.1.1, 3.3.1.3 and 3.4.1, Alternative 1 will not significantly impact the potential for predators to control diseases of wildlife.

5.10 Impacts to Target Predators, Non-target Species, and Ecosystem Function.

We received numerous comments asserting that Alternative 1 would result in significant impacts to target predator populations; non-target species, including threatened and endangered species; and ecosystem function, including biodiversity, ecosystem resilience, trophic cascades, and mesopredator release.

Some of these comments asserted that predator populations would be severely diminished, or even extirpated under Alternative 1. Other comments assert that the EA fails to adequately consider direct, indirect, and cumulative impacts to predators, non-targets, and ecosystem function. Some assert that mountain lion take in the CPW study areas will result in trophic cascades, loss of biodiversity, and interruption of ecosystem services provided by mountain lions. Others state assert that lethal take of wildlife on the scale presented for Alternative 1 has contributed to localized extinction (extirpation) of many North American species, and has fundamentally altered ecosystems. Other commenters assert that

Alternative 1 will result in indirect impacts, including changes to population genetics and demographic shift.

Some commenters assert that the EA admits that there will be potentially significant short-term impacts, and/or local impacts. Other commenters assert that WS-Colorado claims that it is not necessary to consider direct, indirect, and cumulative impacts on ecosystems due to the take of native carnivores under Alternative 1. Commenters cite numerous documents to support their assertions. These are discussed below.

We disagree with these assertions. The potential for these impacts under Alternative 1 was discussed and analyzed in Sections 3.1.1 (target predators), 3.2.1 (non-target species), 3.2.1.1 (threatened and endangered species), and 3.3.1 (ecosystem function). Our analysis determined that Alternative 1 would not result in any significant impacts. The detailed analyses in Section 3.2.1 determined that Alternative 1 would not result in any significant impacts to non-target species populations, including rodents and rabbits.

WS-Colorado analyzed the potential for Alternative 1 to result in impacts on ecosystem function in Section 3.3.1. This analysis included biodiversity and ecosystem resilience (Section 3.3.1.1), as well as trophic cascades and mesopredator release (Section 3.3.1.2). These detailed analyses determined that Alternative 1 would not result in any significant impacts. The potential for Alternative 1 to impact native ecosystems was also addressed in Sections 3.1.1 and 3.2.1. The lack of significant impacts to target and non-target species supports our findings in Section 3.3.1. Some commenters have cited the work of Bergstrom *et al.* (2014) and Estes *et al.* (2011) as evidence that Alternative 1 would result in trophic cascades and mesopredator release. We disagree with this assertion. We considered these documents during the preparation of the EA. The information in these documents is included in the EA in Section 3.3.1, along with citations to these documents. Cumulative predator take under Alternative 1 would be substantially lower than that analyzed in these documents.

We disagree with the assertion that mountain lion take in the CPW study areas will result in trophic cascades, loss of biodiversity, and interruption of ecosystem services provided by mountain lions. All of these potential impacts were considered in Section 3.3.1, as discussed above.

We disagree with the implications that lethal take of wildlife under Alternative 1 would contribute to extirpation of any native wildlife species, or would fundamentally alter ecosystems. These potential impacts were addressed in Sections 3.1.1, 3.2.1, 3.2.1.1, and 3.3.1, as discussed above.

We disagree with the assertions that Alternative 1 would negatively impact population genetics, or result in significant genetic shift in target predator populations. We are not aware of any credible information which would suggest that the potential for a younger age structure in localized coyote populations in the short-term would result in any significant impact, and we have no reason to believe that it would result in any effect, especially on the statewide coyote population, or on any local population in the long-term. We disagree that Alternative 1 would result in significant negative impacts on the population genetics of any target predator species, due to the low levels of take analyzed throughout Section 3.1.1. We included all reasonably foreseeable indirect impacts in Section 3.1.1. The potential for impacts on population genetics was not discussed for any species because it is not reasonably foreseeable based on the low level of take.

The assertions that the EA admits potentially significant local and/or short-term impacts are false. The EA refers to potential short-term, local impacts to certain target predator populations, but these impacts were determined to be non-significant. The assertion that WS-Colorado claims that it is not necessary to consider direct, indirect, and cumulative impacts on ecosystems due to the take of native carnivores under Alternative 1 is false. We made no such claim or implication in the EA. We analyzed the potential for direct, indirect, and cumulative impacts on ecosystems in detail in Section 3.3.1.

We included the information in several of the documents cited by commenters in the EA, and cited them as references. These include: Crooks and Soule (1999), Ripple and Beschta (2012), Bergstrom *et al.* (2013), and Ripple *et al.* (2014).

Several of the documents cited by commenters were considered during the preparation of the EA, but were not cited because they did not add substantively to the information and analyses. These include: Berger *et al.* (2008), Callan *et al.* (2013), Gilbert *et al.* (2016), and Darimont *et al.* (2015).

Two of the documents cited by commenters cover topics which are outside the scope of the EA. Miller *et al.* (2011) studied grizzly bear management in Alaska; this is outside the scope of the EA because there are no grizzly bears in Colorado, as stated in Table 3-15a. Schmidt *et al.* (2017) considered lethal control of wolves; this is outside the scope of the EA, which only considers non-lethal PDM for wolves.

We considered five other documents cited by commenters. They did not add substantively to the information and analyses in the EA. Elbroch and Wittmer (2012) studied food provisioning by mountain lions in Patagonia. Elbroch *et al.* (2015) found that mountain lions interact more than expected in Yellowstone. Weaver *et al.* (1996) reviewed resilience and conservation of large carnivores. Wallach *et al.* (2015) studied self-regulation in apex predators. Bergstrom (2017) is an opinion piece. We considered the opinions of this author.

5.11 Wolves.

We received numerous comments regarding wolves. These comments asserted that lethal PDM for wolves is ineffective, that lethal PDM increases wolf poaching (Chapron and Treves 2016), that there are few wolves left in the country, and that WS-Colorado intends to lethally remove wolves under Alternative 1. One commenter decried the paucity of information on wolves in the EA, including damage and loss data, references, other data, and explanations.

As discussed in Section 3.2.1.1, no extant gray wolf population is known to exist in Colorado. The absence of wolves in Colorado is the reason for the lack of estimated losses due to gray wolves in Colorado, as well as the paucity of citations regarding gray wolf management. Gray wolves are included in the EA because, under Alternative 1, WS-Colorado might conduct non-lethal PDM for gray wolf damage in the event that gray wolves enter Colorado from neighboring states.

It is a false assertion that WS-Colorado intends to, or will, lethally remove wolves in Colorado under Alternative 1. This EA does not contemplate the lethal removal of wolves, as discussed throughout the EA, including Sections 1.16.3.2, 3.2.1.1, Appendix C, and Appendix D. As such, the efficacy of lethal PDM for wolves is outside the scope of the EA. We have consider the content of Chapron and Treves (2016). This article is outside the scope of the EA, because it assesses the impact of lethal removal of wolves.

Wolves which may enter Colorado would currently be considered federally Endangered, and lethal removal would not be allowed under federal law, as discussed in Sections 1.16.3.2, 3.2.1.1, Appendix C, and Appendix D. As stated in Section 2.11.2.3, WS-Colorado will follow federal and state laws regarding wolves in the event that their protected status changes in the future. WS-Colorado will use only non-lethal methods for wolf PDM based on the analysis in this EA. Protective measures incorporated by WS-Colorado should preclude the non-target take of wolves, especially lethal take, as discussed in Section 2.11. However, as stated in Section 2.11.2.3, further NEPA analysis could be conducted in the future by WS-Colorado, USFWS, or a federal land management agency, which might consider the lethal take of wolves in Colorado.

5.12 EIS.

We received numerous comments requesting or stating the need for the preparation of an EIS, for reasons other than significant environmental impacts. Commenters assert that an EIS is required due to: (1) CEQ regulations at 40 CFR §1508.27(b)(5) regarding unique or unknown risks, (2) CEQ regulations regarding actions which are highly controversial, (3) the sensitivity of the issue, (4) the broadness of the proposed action per regulations at 7 CFR 372.5, (5) the CEQ regulations at 40 CFR 1501.3(b), 1501.4(c), 7 CFR 372.9(a), and 40 CFR 1508.3, and (6) the conclusion that Alternatives 3 and 4 would result in increased risks to human health and safety. Other commenters stated that an EIS should be prepared with the latest scientific information. Numerous commenters asserted that an EIS should be prepared to cover all WS-Colorado activities. One commenter asserts that potential violations of federal and state law in the EA, including the Endangered Species Act and the Wilderness Act, require the preparation of an EIS.

The reasons we prepared an EA instead of an EIS are provided in Section 1.16. We disagree that any of the factors asserted by these commenters requires the preparation of an EIS.

We disagree with the assertion that an EIS is required due to unique or unknown risks. We have added language to the EA in Section 2.3.8 regarding Unique or Unknown Risks, based on the CEQ regulations at 40 CFR §1508.27(b)(5), which clarifies how we included this issue in our analyses. We included consideration the degree of uncertainty and unique or unknown risks in our analyses in Chapter 3, and determined that there would be no significant impacts under Alternative 1. Some commenters have asserted that certain statements in the EA meet the threshold of unknown risks, thus requiring the preparation of an EIS. We disagree that these statements or any of the analyses or statements in the EA meet this threshold, as discussed in Section 2.3.8. Many of these statements refer to current and future research, including the CPW predator research projects (Appendices G and H). Uncertainty about the future results of research do not meet the threshold for a determination of significant impact.

We disagree with the assertion that and EIS is required due to highly controversial methods or impacts under Alternative 1. This is discussed in Sections 1.16.2 and 2.3.8. Our analyses in Chapter 3 demonstrate that the Preferred Alternative (Alternative 1) would not significantly impact the environment. We did not find that the magnitude of the impacts would be highly controversial. We have considered the references provided by commenters. Many of these authors disagree with our conclusions in the EA. However, NEPA does not require WS-Colorado to settle disputes among researchers.

We disagree with the assertion that an EIS is required due to the sensitivity of the issue. Neither NEPA, nor the CEQ regulations regarding the implementation of NEPA, require the preparation of an EIS based on the "sensitivity" of an issue.

We disagree with the assertion that and EIS is required based on APHIS' NEPA implementation regulations at 7 CFR 372.5. The scope of the EA fits within the guidelines for an EA.

We disagree that the CEQ regulations at 40 CFR 1501.3(b), 1501.4(c), and 1508.3 require the preparation of an EIS for the proposed action. We also disagree that the APHIS implementing procedures for NEPA at 7 CFR 372.9(a) indicate the need to prepare an EIS for the proposed action.

We disagree with the assertion that significant impacts under Alternatives 3 and 4 require the preparation of an EIS. A finding that the Preferred Action is superior to one or more of the other alternatives analyzed does not require the preparation of an EIS.

We disagree that an EIS should be prepared which contains the latest scientific information. We also disagree with the implication that this EA does not contain the latest scientific information. The EA contains the best available scientific information on the impacts of the alternatives considered in detail.

We disagree that an EIS should be prepared which covers all WS-Colorado activities. WS-Colorado limited this EA to PDM actions because APHIS-WS has determined that these actions are sufficiently different from other APHIS-WS actions as to warrant consideration in separate NEPA analyses. A discussion of this determination was added to the EA in Section 1.16.2.

It is a false assertion that the EA contemplates violations of law, including the Endangered Species Act and the Wilderness Act. Alternative 1 would not violate any laws, including the Endangered Species Act and the Wilderness Act. Our compliance with federal, state, and local laws is stated throughout the EA, including Section 1.11.2. Our compliance with the Endangered Species Act and the Wilderness Act is discussed in Sections 1.16.5.2, 1.16.5.9, and 3.2.1.1, and Appendices C and D.

We found that there would be no significant impacts under Alternative 1 (Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1); thus, an EIS is neither warranted nor required.

5.13 Efficacy and Cost-Efficacy.

We received several comments which asserted that the Preferred Alternative (Alternative 1), or lethal PDM in particular, would not be efficacious or cost-effective, some asserting that lethal PDM costs five dollars for every one dollar of livestock loss (Alcock 1990). Commenters assert that lethal PDM, especially for mountain lions, wolves, and black bears, results in more attacks on livestock, and thus higher losses, according to Peebles *et al.* (2013), Lambert *et al.* (2006), and Bryan *et al.* (2015). Commenters also assert that lethal PDM is not effective for coyotes because they change breeding and immigration strategies to compensate for lethal removal, according to Olsen (1971), Keefover-Ring (2009), Keefover (2012), Knudson (2012), Bergstrom *et al.* (2013), HSUS (2015), and Bergstrom (2017). Other commenters assert that subadult predators which immigrate after lethal removal are more likely to depredate livestock than the adults which were removed, according to Peebles *et al.* (2013).

Some comments assert that cost-benefit analysis was absent from the EA, or is required by NEPA. A few commenters assert that preventive PDM is not effective and may exacerbate losses; that surrounding producers experience increased depredation losses after lethal PDM; and that WS data document that lethal PDM does not work.

We disagree with the assertions that Alternative 1, or lethal PDM in particular, are not effective, or cost-effective. Based on the thorough discussion and analyses in Sections 1.18 and 1.19, the PDM proposed under Alternative 1, including lethal PDM, is an effective use of tax dollars. Cost-benefit audits by OIG and GAO were discussed in Sections 1.18.2.1 and 1.18.2.2; recent studies on the cost-effectiveness of WDM (many of which were conducted by APHIS-WS) were discussed in Sections 1.19.3 and 1.19.4; and other considerations were discussed in Section 1.19.6.1. Lethal PDM is part of the integrated PDM conducted by WS-Colorado and APHIS-WS, and is therefore included in these analyses.

The lethal PDM methods discussed in the EA have been shown to be effective in resolving conflicts with mammalian predators (Sections 1.18, 1.19, 2.6, 3.1.1, and Appendix A). According to the analysis in the EA, WS-Colorado's integrated approach to PDM, including both nonlethal and lethal methods, is the most effective in resolving conflicts with mammalian predators (Sections 3.1.1 and 3.7.1 through 3.7.4). The literature we cited in these Sections and elsewhere in the EA supports the value and efficacy of lethal PDM.

We disagree with the assertion that five taxpayer dollars are spent for every one dollar of livestock losses. We have considered the content of Alcock (1990). We disagree with the analysis provided by this author. The analysis did not consider the value of animals saved, and is therefore a faulty analysis. The value of animals saved from predation is discussed in Section 1.18.4. This document does not add substantively to the analyses in the EA.

We disagree with the assertion that lethal PMD results in more livestock depredation and higher losses, as discussed in Section 2.6.9.4. The research of Peebles *et al.* (2013) and Lambert *et al.* (2006) was considered and cited in the EA. Lambert *et al.* (2006) did not study the impacts of mountain lion removal on livestock losses, but speculated that there might be a positive correlation, based on the results of their study. Peebles *et al.* (2013) found a correlation between lethal removal of mountain lions through heavy hunting, and livestock depredation; however, this correlation does not demonstrate causation, and other studies have found conflicting results, as discussed in Section 2.6.9.4. The CPW predator study in the Upper Arkansas (Section 2.6.9.4 and Appendix H) aims to add to the body of work on this subject, as discussed in Section 2.6.9.4. The work of Bryan *et al.* (2014) was considered. These authors studied lethal removal of wolves through hunting. This research is outside the scope of the EA, because Alternative 1 includes only non-lethal PDM for wolves. Moreover, these authors reported that they were not able to determine the relative importance of hunting pressure, habitat, and sampling on their observed effects. This document was not included in the EA because it did not add substantively to the information or analyses provided.

We agree that coyotes alter their breeding behavior and immigration strategies in response to lethal removal, as discussed in Section 2.3.2, and 3.1.1. We disagree with the assertion that these strategies infer that lethal PDM is ineffective, as discussed in Sections 2.3.2, and 3.1.1. Olsen (1971) is a book which contains no original scientific research. Keefover-Ring (2009), Keefover (2012), and HSUS (2015) are self-published opinion pieces which contain no original scientific research. Knudson (2012) is a newspaper article which contains no original scientific research. Bergstrom (2017) is an opinion piece which contains no original scientific research. None of these documents provide any useful information to support the commenter's assertions. These documents have been considered. They do not add substantively to the information or analyses in the EA. Bergstrom *et al.* (2013) is an opinion piece which contains no original scientific research. This document was considered during the preparation of the EA, and is cited as a reference.

We disagree that subadult predators are more likely to depredate livestock than the animals removed during PDM. Bergstrom *et al.* (2013) report that territorial breeding pairs of coyotes "commit most depredations on sheep," which contradicts this assertion for coyotes. Other authors have found similar results for coyotes, as discussed in Sections 2.3.2, and 3.1.1. The results of Peebles *et al.* (2013) support this assertion for mountain lions, but other studies have found conflicting results, as discussed in Section 2.6.9.4. The CPW predator study in the Upper Arkansas (Section 2.6.9.4 and Appendix H) aims to add to the body of work on this subject, as discussed in Section 2.6.9.4.

We disagree with the assertions that the EA fails to include a cost-benefit analysis, and that a cost-benefit analysis is required by NEPA. NEPA does not require formal cost-benefit analyses for every federal action, as discussed in Section 1.19. Nonetheless, the EA contains a thorough discussion of economic analysis in Section 1.19, cost-benefit audits by OIG and GAO in Sections 1.18.2.1 and 1.18.2.2, and recent studies on the cost-effectiveness of WDM (many of which were conducted by APHIS-WS) in Sections 1.19.3 and 1.19.4.

We disagree with the assertions that preventive PDM is not effective, and may exacerbate losses. We are not aware of any credible data or research to support this claim. We discussed the effectiveness of APHIS-WS PDM Programs, including preventive PDM, in Sections 1.18 and 1.19 as noted in this response above.

We disagree with this assertion that surrounding producers experience increased depredation losses after lethal PDM. We are not aware of any credible data or research which would support this assertion, and the commenter does not provide any citations. Some authors cited by other commenters (*e.g.*, Santiago-Avila *et al.* 2018) have suggested that this may be the case for wolf removal; however, their data are not convincing due to their study design, small sample size, and lack of statistically significant results. Moreover, this topic is outside the scope of the EA because Alternative 1 only includes non-lethal PDM for wolves.

It is a false assertion that WS data document that lethal PDM does not work. It is unclear how the commenter believes that WS data would support this assertion. If the commenter is referring to the continued take of similar numbers of predators, mostly coyotes, every year, which demonstrates that the coyote population is not declining due to PDM, then the commenter misunderstands the objectives of the WS-Colorado PDM Program, as discussed in Section 1.11.2, and in this Chapter.

One commenter requested additional information on the cost-efficacy of aerial PDM. The best available sources for information on the cost-efficacy of aerial PDM are the cost-benefit audits by OIG and GAO in Sections 1.18.2.1 and 1.18.2.2, and recent studies on the cost-effectiveness of WDM (many of which were conducted by APHIS-WS) in Sections 1.19.3 and 1.19.4.

5.14 Ethics and Humaneness.

We received numerous comments on the topic of humaneness. Some commenters assert that Alternative 1, or lethal PDM, is inhumane. Other commenters assert that the EA fails to adequately address ethical considerations because it does not contain an in-depth analysis covering the entire discipline of ethics. One commenter asserts that the EA misrepresents public concerns about humaneness by misrepresenting Schmidt 1989, and that public concerns do not revolve exclusively around the definition of unnecessary pain. One commenter states that some captured animals die from exposure before WS-personnel check the trap, and that dogs have been captured in WS traps.

Other commenters assert that lethal methods of PDM are highly unpopular with the American public, according to Slagle *et al.* (2017). Numerous commenters assert that no animals should be killed, that people do not have the right to interfere with natural processes, that nature should be left alone and allowed take its course, or that they opposed all wildlife management. These comments all reflect the opinion that wild animals, including predators, have intrinsic value.

As discussed in Section 3.6.1.1, WS-Colorado understands that Alternative 1 may not be acceptable to some individuals based on their values and/or beliefs. Humaneness and ethics are discussed in Section 2.2.6; humaneness and ethics issues under Alternative 1 are discussed in Section 3.6.1.1. The protective measures implemented by WS-Colorado, as discussed in Section 2.11, and the descriptions of methods provided in Appendix A, provide further information on the humaneness of WS-Colorado's implementation of Alternative 1. Selectivity of the various methods also relates to humaneness, as discussed in Section 3.2. More selective methods are considered more humane methods, because they reduce unnecessary pain and suffering in non-target animals. As discussed in Section 3.2.1, WS-Colorado uses the most humane and selective methods practical for each predator damage situation. Further analysis in Sections 3.2.2, 3.2.3, 3.2.4, 3.6.2, 3.6.3, and 3.6.4 address humaneness under the other alternatives considered in detail, based on the best available information.

We disagree that the EA fails to adequately address ethical considerations. We discussed and analyzed this topic in Sections 2.2.6.1, 2.2.6.2, and 3.6.1.1. An in-depth analysis covering the entire discipline of ethics is outside the scope of this EA.

We disagree that the EA misrepresents the content of Schmidt (1989). This research shows that the public is concerned about unnecessary pain.

Public opinions regarding wildlife were discussed in Section 1.6, including Table 1-2. We have considered the content of Slagle *et al.* (2017). This is an assessment of public opinions regarding predator control. It does not add substantively to the information or analyses in the EA, because similar information is presented in Section 1.6. The content of this article does not alter the analyses conducted in Chapter 3 regarding the potential impacts of any of the Alternatives on the environment.

We understand that some individuals believe that all animals have intrinsic value. Intrinsic value was discussed in Sections 1.6 and 3.6.1.1. The issue of impacts on individual animals was discussed in Section

2.4. Impacts on individual animals were not evaluated in detail for the reasons discussed in that Section. Wildlife management is discussed in Section 1.8. A discussion of the merits of wildlife management is outside the scope of this EA. As discussed in Section 1.8, WS-Colorado generally conducts WDM, not wildlife management; the goal of WDM is generally "to alleviate the damage [caused by wildlife], without affecting overall or regional populations." To the extent that WDM might be considered to be a subset of wildlife management, this comment might be interpreted to include opposition to WDM as well. The propriety of conducting WDM was discussed in Sections 1.5, 1.6, 1.7, 1.11, 2.10.2, and 3.6.1.1.

5.15 Healthy Ecosystems.

We received numerous comments regarding healthy ecosystems. These comments assert that healthy ecosystems are important, and that native predators play important roles in maintaining healthy ecosystems.

We agree with the assertions that healthy ecosystems are important, and that native predators play important roles in maintaining healthy ecosystems. Some commenters have claimed that WS-Colorado's opinion is that predators are not important for ecosystem health, and that the EA fails to give proper consideration to the positive values of carnivores, including ecosystem services, recreation, and eco-tourism. These are false assertions. One of the objectives of WS-Colorado is to "Implement PDM so that cumulative effects do not negatively affect the viability of any native predator populations," as discussed in Section 1.12.2. The importance of predators to their ecosystems is discussed or referenced in Sections 1.4, 1.5, 1.10, 1.12, 1.12.2, 1.12.3, 2.6.2, 2.10.15, 2.11, 3.3, and 3.3.1.3. The information in these Sections demonstrates WS-Colorado's belief and understanding that predaors are important parts of their ecosystems. The discussions in Chapter 3 are especially demonstrative of this. In order to clarify this early in the EA, we added information to the Final EA in Section 1.4.

Some commenters have cited Henke and Bryant (1999) as evidence of the critical role of coyotes in maintaining species diversity. We agree with this interpretation, as discussed in Section 3.3.1.1, where the study by Henke and Bryant (1999) was cited and discussed. We disagree with the implication that WS-Colorado would significantly impact coyote populations, and thus species diversity, under Alternative 1, as discussed and analyzed in Sections 3.1.1.1 and 3.3.1.1.

5.16 Need.

We received numerous comments regarding the need for PDM in Colorado. Many of these comments assert that there is no need for PDM to protect certain assets (*e.g.*, healthy livestock, humans, and pets) from certain predators (*e.g.*, wolves, coyotes, and mesopredators), or that the need for PDM was inadequately described or justified. Other comments criticize the use of unverified, producer-reported data, such as those in NASS reports, because they might reportedly be exaggerated or otherwise inaccurate (Baker *et al.* 2008, Keefover 2012). Still other comments argue that most livestock losses are higher due to causes other than predation (USDA 2017), which implies that there is no need for PDM to protect livestock.

We disagree with the assertions that there is no need for PDM in Colorado, and that we failed to adequately justify the need for PDM in this EA. The need for PDM was thoroughly assessed throughout Section 1.17, including the need to protect livestock (Section 1.17.2), property (Section 1.17.3), humans and pets (Section 1.17.4), and natural resources (1.17.5). We used the best available data in this EA. In Section 1.17, this includes NASS data and APHIS data, which are based on reports by livestock producers, as well as WS-Colorado MIS data. We added information to the Final EA in Section 1.17, regarding our experiences regarding the accuracy of producer-reported data. These data are presented in Tables 1-3, 1-4, 1-5, 1-6, and 1-7, and Figures 1-1, 1-2, 1-3, 1-4, and 1-5. These data show that many Colorado predator species affect livestock, property, humans, pets, and natural resources.

The data presented throughout Sections 1.17 demonstrate the damage and damage threats posed by most of the predator species included in this EA, including coyotes, black bears, mountain lions, raccoons, striped skunks, red fox, feral dogs, bobcats, badgers, and opossums. Poultry are livestock, and many of the mesopredators have been documented to depredate poultry as noted in Section 1.17. Some predator species included in the EA have not been documented to impact livestock. However, the EA covers all damage caused by predators, not just livestock depredation, as discussed in Section 1.17.

Specific types of predator damage are also addressed in the EA for each target predator species considered, in Sections 3.1.1.1 through 3.1.1.19. Damage caused by some predator species in this EA is occasional and sporadic, including swift fox (Section 3.1.1.12), feral domestic ferrets (Section 3.1.1.13), gray fox (Section 3.1.1.14), spotted skunks (Section 3.1.1.15), long-tailed weasels (Section 3.1.1.16), short-tailed weasels (Section 3.1.1.16), American marten (Section 3.1.1.17), American mink (Section 3.1.1.18), and ringtails (Section 3.1.1.19). As discussed in Section 3.1.1.20, wolf damage is currently rare in Colorado, because no extant wolf population is known to exist in the state. No wolf predation has been documented in Colorado in recent decades, and no wolf losses are reported in Section 1.17.

Some comments suggest that predators only prey on sick or unhealthy animals. This is incorrect. As discussed in Section 1.17.5.1, predators might selectively prey on vulnerable individuals. This vulnerability includes illness, and many other factors. Livestock are inherently vulnerable due to their domestication and selection for economically important traits.

We disagree with the implication that losses due to non-predation causes negate the need for PDM. We addressed and discussed other causes of livestock losses in Section 1.17.2.2, and included our reasoning for not discussing them further. Livestock losses due to causes other than predation do not negate or affect our analyses. We included and discussed the information in APHIS 2017 in Section 1.17, and cited this document.

Baker *et al.* (2008) and Keefover (2012) were cited by some commenters as evidence that NASS data are exaggerated. Baker *et al.* (2008) state that producer-reported losses might be exaggerated, but neither they nor their source for this statement provide any data to support their assertion. Keefover (2012) is an opinion piece by HSUS which contains no original scientific research. We have considered the opinion of this author regarding the potential for producer-reported data to be exaggerated. This document does not add substantively to our analysis.

One commenter asserted that we failed to include the number of entities assisted, the percentage of livestock producers who benefit, for whom services will be provided, the economic importance of ranching, and the proportion of livestock losses attributable to predation. The commenter further asserted that the lack of this information is a failure to show sufficient need for PDM. We disagree with these assertions. The need is established in Sections 1.17.2 and 1.17.2.5, where the number of livestock producers suffering predation losses is reported to be about 4% of cattle operations and 10-12% of sheep operations in a given year. Also, the importance of ranching is addressed in Section 1.17.2.1. The proportion of livestock losses attributable to predation is addressed in Section 1.17.2.3, and in the NASS survey data cited in Section 1.17 (NASS 2011, 2012, and 2015). The most recent loss data published by VS (2017) has also been included.

5.17 Lethal PDM.

Comments: We received numerous comments regarding the use of lethal PDM methods. These comments opposed lethal PDM for the protection of certain resources (livestock, property, pets, and ungulates), in certain areas (public lands, federal lands, and wilderness areas), or combinations thereof. Lack of selectivity and efficacy were reported as reasons for opposition to lethal PDM. Some commenters opposed the number of animals removed during lethal PDM, or opposed the "excessive" take of predators. Some commenters oppose lethal PDM as the first or only choice,

preferring that non-lethal methods be attempted first. Commenters also asserted that Alternative 1 does not include any limits to predator removal.

Response: We understand that some individuals will not agree with the use of lethal PDM. We considered an alternative which would exclude lethal PDM in Section 2.10.3. This alternative was not considered in detail because it would be nearly identical to Alternative 3: WS-Colorado Provides technical assistance only. Our analysis determined that Alternative 3 would not accomplish the goals and objectives of WS-Colorado and APHIS-WS as well as Alternative 1 (Section 3.7.3). Direct, indirect, and cumulative impacts under Alternative 3 would be the same as those under Alternative 1 for target predator species populations (Section 3.1.3), non-target species populations (Section 3.2.3), and ecosystem function (Section 3.3.3). However, human and pet health and safety (Section 3.4.3) and other sociocultural issues (Section 3.6.3) would likely be significantly impacted under this alternative. Impacts on public lands would be slightly negatively affected under Alternative 3 (Section 3.5.3).

We analyzed the potential for Alternative 1, including lethal PDM methods, to result in negative environmental impacts in Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1, and determined that it would not result in any significant impact on the environment. This assessment includes the potential for impacts on target predators (Section 3.1.1), non-target species (Section 3.2.1), threatened and endangered species (3.2.1.1), ecosystem services (3.3.1), human and pet health and safety (Section 3.4.1), public lands (Section 3.5.1), and special management areas such as wilderness areas (Section 3.5.1.4), as well as humaneness and other sociocultural issues (Section 3.6.1). In Section 3.7, we analyzed the ability of four alternatives to meet the goals and objectives of APHIS-WS and WS-Colorado, and Alternative 1 was determined to best accomplish these.

We understand that some individuals will not agree with the use of lethal PDM in some circumstances. Throughout Section 1.17, we analyzed the need for PDM. We discussed several needs, including protection of livestock, protection of agricultural resources other than livestock, protection of human and pet health and safety, and protection of natural resources. WS-Colorado employs an integrated predator damage management approach to resolve conflicts with mammalian predators, as discussed in Section 1.10 and elsewhere. This approach involves the use of a variety of nonlethal and lethal methods appropriate to the situation, as discussed in Sections 1.9, 1.11, 2.6, and Appendix A.

Specific research projects by CPW to assess the influence of predation on mule deer population dynamics are discussed in Section 2.6.9.4, and the CPW study plans are provided in Appendices G and H. Based on the results of these studies, CPW might ask for assistance from WS-Colorado in the future to protect ungulate populations using PDM, including lethal PDM, as discussed in Section 1.17.5.

Some commenters cited the 2012 letter of opposition to lethal PDM from the American Society of Mammalogists. We considered the opinions of these authors. This letter did not add substantively to the information or analyses in this EA.

We disagree with the assertions that lethal PDM is ineffective and non-selective. WS-Colorado recognizes that some individuals will oppose the Preferred Alternative (Alternative 1) in the EA for various reasons. We discussed the effectiveness of APHIS-WS PDM Programs, including lethal PDM, throughout Sections 1.18 and 1.19. This is specifically addressed in Section 1.18.2. We used the best available science, and cited our sources. Lethal methods of PDM used by WS-Colorado can also be highly selective when used appropriately by conscientious wildlife professionals, as discussed in Sections 2.6 and 2.11, throughout Chapter 3, and in Appendix A. As discussed in Section 3.2.1, WS-Colorado uses the most humane and selective methods practical for each predator damage situation.

We disagree with the implications that WS-Colorado conducts lethal PDM as the first or only choice. As discussed in Sections 1.11.2, 1.11.4, 1.15.3, and 2.6.2, WS-Colorado employees start with the WS Decision model by collecting information from the producer, evaluating the range of methods that would work for the given ranch, then choosing which methods would be appropriate to implement to reduce livestock predation losses. As part of the integrated program the livestock producer is already implementing a number of non-lethal methods including guard dogs, range riding, herders, shed lambing, fencing and carcass disposal. WS-Colorado gives preference to the use of non-lethal methods over lethal methods whenever they are practical and effective. WS-Colorado employs an integrated predator damage management approach to resolve conflicts with mammalian predators, as discussed in Section 1.10 and elsewhere throughout the EA. This approach involves the use of a variety of nonlethal and lethal methods appropriate to the situation, as discussed in Sections 1.9, 1.11, 2.6, and Appendix A. In Section 2.10.4, we considered an Alternative to use only lethal methods, but this alternative was not considered in detail for the reasons cited in that Section.

We disagree with the implication that Alternative 1 would result in "excessive" take of target predators. WS-Colorado would take only a small percentage of the estimated populations of any predator species, as discussed in Section 3.1.1: less than 0.1% for most species, less than 0.2% for raccoon and red fox, less than 0.8% for mountain lions, less than 1.2% for black bears, and less than 2% for coyotes. These levels of take would allow us to achieve our objective to "[i]mplement PDM so that cumulative effects do not negatively affect the viability of any native predator populations" (Section 1.10.2). We assessed the potential for direct, indirect, and cumulative impacts due to these actions, and found that there would be no significant impacts (Section 3.1.1).

We disagree with the assertion that Alternative 1 would not include limits on lethal PDM. The analyses in this EA provide the general range of lethal take expected under Alternative 1 (Section 3.1.1). As stated in Section 2.6.5 and 3.8, WS-Colorado will conduct regular monitoring in order to ensure that our PDM activities remain within the scope analyzed in this EA. WS-Colorado will conduct additional NEPA analyses if they are determined to be warranted (Sections 2.6.5 and 3.8). These processes preclude sustained take beyond that which is analyzed in this EA, or in future NEPA analyses. In addition, WS-Colorado only conducts PDM in response to need, as discussed throughout the EA (*e.g.*, Sections 1.11.2, 2.6, and 3.1.1); this precludes lethal take beyond that which is necessary to prevent predator damage. These procedures provide the limits to lethal PDM to that which is analyzed in this EA.

One commenter requested specific caps on how often various method would be used, how many target predators would be removed lethally by the various methods, and the amount of time spent conducting the various PDM methods. However, such limitations by method or location are not feasible due to the unpredictable and sporadic nature of many predator damage incidents, as discussed in Sections 3.1.2 and 3.2.2. Moreover, such limits by PDM method would unnecessarily limit the efficacy of the integrated PDM conducted by WS-Colorado. A partial exception is the use of aerial PDM for preventive PDM, as discussed in Section 3.1.2. For this method, we provided specific information broken down by species, land class, and county in the EA.

5.18 Non-lethal PDM.

We received numerous comments regarding the use of non-lethal PDM. Most of these comments asserted that non-lethal methods are effective. Many of these comments assert that non-lethal methods are more effective, cheaper, more socially acceptable, and/or longer-lasting than lethal PDM. Some comments address specific non-lethal methods (these are included in the response below).

We agree that non-lethal PDM methods can be effective in some circumstances. Some commenters have cited research on the efficacy of non-lethal PDM methods, including Gehring *et al.* (2011), Davidson-Nelson and Gehring (2010), and Gehring *et al.* (2010). APHIS-WS has conducted much of the research on these methods, including co-authoring two of these three papers (Gehring *et al.* 2010, and Gehring *et al.* 2011). Davidson-Nelson and Gehring (2010) studied the use of fladry to decrease wolf depredation, Gehring *et al.*

(2010) assessed the use of livestock protection dogs, and Gehring *et al.* (2011) assessed the use of electric fences in conjunction with livestock protections dogs. We are familiar with this research. We considered the content of these articles. We propose to use and recommend these non-lethal methods under Alternative 1 (Sections 2.6.5, 2.6.6, and 2.10.6, and Appendix A). These articles are not cited in this EA because they are outside the scope of the EA. The intent of the EA is not to determine which non-lethal methods are effective, but to determine whether Alternative 1 would result in a reduction of resource losses, minimize environmental impacts, and whether other alternatives might be more appropriate.

WS-Colorado employs an integrated predator damage management approach to resolve conflicts with mammalian predators, as discussed in Section 1.11 and elsewhere. This approach involves the use of a variety of nonlethal and lethal methods appropriate to the situation, as discussed in Sections 1.10, 1.12, 2.6, and Appendix A. The nonlethal methods used and recommended by WS-Colorado are used or recommended precisely because they are expected to be effective when used in the appropriate circumstances (Sections 2.6.5, 2.6.6, and 2.10.6, and Appendix A). These methods include keeping livestock away from areas where predators have ambush cover, risk mapping (we do not use this phrase but the methods we recommend produce the same effect), fencing and penning, moving animals, range riders, herders, guard animals, change livestock type, concentrate and synchronize calving season, frequent checks, carcass removal, and auditory and visual deterrents. We have considered the protection of principle prey herds. However, native predators continue to depredate livestock regardless of the availability of principle prey. As more nonlethal methods become available and are shown to be effective, WS-Colorado will consider them for use in appropriate circumstances.

We agree that non-lethal methods are more socially acceptable by individuals not involved in livestock production, as discussed in Section 3.6.1.

Stone *et al.* (2017) and Barnes (2005) were cited by numerous commenters to support the assertion that non-lethal PDM is more effective than lethal PDM. We disagree that these documents show that non-lethal PDM is more effective than lethal PDM. Stone *et al.* (2017) did not actually assess lethal versus non-lethal PDM, because no lethal PDM was conducted until the last year of the seven year study. What they effectively assessed was their non-lethal approach versus no PDM (or less non-lethal PDM). Whether their data show efficacy of their nonlethal methods is arguable, due to design and analysis issues. The information does not add substantively the information or analyses in this EA. Stone *et al.* (2017) also studied wolves, and because lethal PDM for wolves is not included in this EA (Sections 1.16.3.2, 3.2.1.1; Appendices C and D), the research is outside the scope of the EA. We considered the content of Barnes (2005). It does not add substantively to the information and analyses in this EA, because it is a self-published opinion piece which contains no primary scientific research. We have considered the opinions of this author; they are not convincing.

We disagree that non-lethal PDM methods are more effective, cheaper, and result in longer-lasting than lethal PDM. We are not aware of any reliable information or data to support these assertions. Some commenters cited Lambert *et al.* (2006), Peebles *et al.* (2013), and Maletzke *et al.* (2014), Zarco-Gonzalez and Monroy-Vilchis (2014), and Wallach *et al.* (2017) as evidence that non-lethal PDM is more effective, longer-lasting, and/or more socially acceptable than lethal PDM. We disagree with the commenters' interpretation of these studies. Lambert *et al.* (2006), Peebles *et al.* (2013), and Maletzke *et al.* (2014) did not compare lethal PDM to non-lethal PDM, and did not make any such claims. Zarco-Gonzalez and Monroy-Vilchis (2014) found that deterrents were effective in their study; they did not assess whether they were more effective, longer-lasting, or more socially acceptable than lethal PDM. As noted by the authors, Wallach *et al.* (2017) did not actually compare depredation rates with and without lethal PDM, so they could not assess the effects of lethal PDM on depredation. Their data were also limited to 8 depredation events; such a small sample size is of very little value.

Some commenters have suggested that ranchers should increase the use of non-lethal methods. This topic is addressed in Sections 1.18.2 and 2.6.6, as well as Appendix A. WS-Colorado does not have the authority to require ranchers to utilize any specific non-lethal method, as noted in Section 2.10.20. We do provide information and education regarding the use of non-lethal methods, as discussed in Sections 1.2, 1.17.1, and 2.6.4.

5.19 Non-target take.

We received numerous comments regarding the potential for non-target take under Alternative 1. These commenters asserted that Alternative 1 would result in significant non-target take, that threatened and endangered species would be significantly impacted, that non-target take would be higher than reported in the EA, or that we failed to adequately address non-target take in the EA.

We disagree with these assertions. The potential for Alternative 1 to impact non-target species populations, including threatened and endangered species, is discussed and analyzed throughout Section 3.2.1, including 3.2.1.1. WS-Colorado rarely takes non-target species during PDM. Alternative 1 was determined to have no significant impact on non-target species populations, including threatened and endangered species. These analyses include WS-Colorado assistance with the CPW predator research studies referenced in Section 2.6.9.4 and Appendices G and H.

The analysis period for the EA is the five-year period of federal Fiscal Year 2012-2016, and stated in Section 1.16.3. The non-target take for WS-Colorado during this period is discussed in Section 3.2.1 and Table 3-13. In the interest of transparency, and to provide the best analysis of non-target take, we also included lethal non-target take data for WS-Colorado back to federal Fiscal Year 2004. Non-target take for this 14-year period was discussed and analyzed in Section 3.2.1, and in Table 3-14.

WS-Colorado takes many precautions to minimize the likelihood of taking non-target animals, including threatened or endangered species, including: (1) WS-Colorado employs a variety of protective measures, as discussed in Section 2.11; (2) WS-Colorado consults with the USFWS, as discussed in Section 3.2.1.1 and Appendices C and D, in order to minimize the likelihood of impact to any threatened or endangered species; (3) WS-Colorado conducts NEPA analyses, such as this EA, to ensure that our activities will not negatively impact non-targets, including threatened or endangered species; (4) WS-Colorado works with state and federal land managers, as discussed in Section 1.15, to ensure that our activities will not damage any critical habitat, or otherwise affect any threatened or endangered species on the lands they manage; (5) WS-Colorado works with CPW, as discussed in Section 1.14, to ensure that state-listed species are protected; and (6) WS-Colorado follows federal, state, and local laws (*e.g.*, Section 1.12.2), including those intended to protect listed species.

Our analyses of the potential for non-target take under Alternative 1 (Section 3.2.1) were thorough, and based on the best available information and science. We analyzed the potential impacts on all non-target species which might potentially be taken, based on this information, and assessed the likely impacts on the populations of these species. This includes all threatened and endangered species mammals known to exist in Colorado, as well as some which are not currently known to exist in Colorado (*e.g.*, gray wolf and wolverine).

Two documents were cited as evidence that Alternative 1 would significantly impact non-target animals: Knudson (2012) and Bergstrom *et al.* (2013). Knudson (2012) is a newspaper story, which does not include any primary scientific research. We considered the content of this article. It does not add substantively to the analyses in the EA. Bergstrom *et al.* (2013) is an opinion piece. It is not unbiased scientific literature, and contains no primary scientific research or data. The content of this article was considered during the preparation of this EA, and it is cited herein.

5.20 Human and Pet Health and Safety.

We received numerous comments regarding the potential for impacts to human and pet health and safety under Alternative 1. These comments claim that WS-Colorado would significantly impact human and/or pet health and safety. Some commenters were concerned about human safety on public lands. Some commenters asserted that dogs would be mistaken for coyotes or wolves and accidentally shot. One commenter asserted that the use of explosives and firearms would be harmful to humans and pets. Concerns about potential impacts from M-44 devices, traps, and snares were addressed in different comments.

We disagree with the assertions that human or pet health or safety would be negatively impacted under Alternative 1. Potential impacts to human and pet safety under Alternative 1 were analyzed in Section 3.4.1. Alternative 1 was determined not to result in any significant impact to human or pet health or safety in this Section. Non-target take under alternative 1 was analyzed in Section 3.2.1, which includes any take of pets. In this Section, we analyzed lethal non-target take between federal fiscal year 2004 through 2017. During this 14 year period, WS-Colorado did not lethally take any pets (Section 3.2.1 and Table 3-14). During FY12-16, WS-Colorado captured one non-target domestic dog, which was immediately released unharmed, as discussed in Section 3.2.1.

We disagree with the assertion that humans would be negatively impacted on public lands under Alternative 1. The analyses in Section 3.4.1 include humans using public lands. The potential for impacts on public recreation was analyzed in Section 3.5.1. Alternative 1 was determined not to result in any significant impacts.

We are not aware of any credible information to suggest that any pets have been mistaken for coyotes or wolves and accidentally shot during PDM in recent years. WS-Colorado did not accidentally shoot (or otherwise lethally take) any pets during the 14-year timeframe analyzed in Section 3.2.1 (federal fiscal year 2004 through 2017; Table 3-14). Shooting is one of the most selective methods of lethal PDM, and it is extremely unlikely that WS-Colorado would accidentally shoot a pet during PDM.

We disagree with the assertion that firearms would be harmful to humans and animals under Alternative 1. The potential for Alternative 1 to impact non-target species populations was addressed in Section 3.2.1, and were determined not to be significant. The potential for undue harm to animals was analyzed in Section 3.6.1, and determined not to be significant. As noted above, shooting is one of the most selective methods of PDM. The risk to non-target animals, pets, and human safety is negligible.

It is unclear what the commenter means by explosives. The only explosives used by WS-Colorado for PDM are propane canons and pyrotechnics, as discussed in Section 2.6.6 and Appendix A. These methods do not pose any significant risk to human health or safety, and pose no risk to animals.

5.21 Science.

We received numerous comments regarding the science used by WS-Colorado in the EA. The commenters assert that WS-Colorado did not use the best science, uses outdated science, ignored dissenting scientific documents and opinions, and failed to consider important relevant documents. Commenters cite Soule *et al.* (2005), Eklund *et al.* 2017, and Treves *et al.* 2016 as the best available science, and list numerous referenced cited in the EA as examples of poor science. Cites Mitchell *et al.* 2004 as evidence that Wagner and Conover 1999 used poor science which was rigged to produce the authors' desired outcomes. Some commenters assert the need for more and better predator population data.

We disagree with the assertions that WS-Colorado did not use the best available science in the EA, used outdated science, ignored dissenting scientific documents and opinions, and failed to consider important relevant documents. We used the best available information and science in the preparation of the EA. We considered numerous documents which were relevant to the topics in the EA, but did not add substantively to the information and analyses in the EA. This was largely because we cited other references which contained similar information for the purposes of the analyses. We did not cite these documents as references in the EA because we believe they do not add substance to the EA. During the preparation of the EA, we considered all relevant studies which we were aware of, including more than 1,000 documents. Not all studies were cited; only those which added substantively to the information and analyses in the EA. Dissenting opinions and documents with dissenting data and conclusions were included throughout the EA.

Commenters have cited numerous studies, and we have considered the content of those studies. Soule *et al.* 2005 (Strongly interacting species: conservation policy, management, and ethics; BioScience 55:168-176) is an opinion piece. The opinions of these authors have been considered. We disagree that this document represents the best available science; it does not contain any primary scientific research. This document does not add substantively to the information or analyses in the EA. We considered the content of Eklund *et al.* 2017. These authors determined that only 562 of 27,781 predator control publications met their criteria for scientific merit. And only 21 of those used excellent methodologies. This article does not add substantively to the information or analyses in the EA. Whether or not some of these studies met the criteria established by these authors does not imply that better science is available.

Mitchell *et al.* 2004 critiqued the research methods of Wagner and Conover 1999. However, they also referred to this study as "[t]he best available research on the efficacy of this method." We disagree with the assertions that Wagner and Conover 1999 is poor science, that their methods were rigged to produce desired outcomes, and that the critique by Mitchell *et al.* 2004 is evidence of either of the preceding assertions. We used the best available research during the preparation of the EA, including Wagner and Conover 1999.

We disagree with the assertion that the information presented by Treves *et al.* (2016) represents the best available science. We further disagree with the content of Treves *et al.* (2016), for the reasons discussed in Sections 1.18.3, 2.10.28, and Appendix E.

We agree that it would be useful to have better data on predator populations. However, useful and accurate data on predator populations are difficult to achieve. We used the best available data in the EA.

5.22 Statewide Population Analyses.

We received several comments regarding the decision to use statewide populations to assess the potential impacts on predator populations under Alternative 1. Commenters disagreed with analysis at the statewide level, and asserted that the proper or appropriate levels for these analyses are local, regional, or DAU.

We disagree that impacts in the EA should be measured at local, regional, or DAU levels for the reasons discussed in Sections 1.15.3, 1.15.4, and 1.16.3, and within the impact analyses for individual target predator populations in Section 3.1.1. Further clarification of our reasoning was added to Section 1.16.2. Our analyses of potential impacts on statewide populations in Section 3.1.1 indicate that this level of analysis is not warranted, because the proportion of cumulative take contributed by WS-Colorado is extremely low for all native predators targeted during PDM. There is no reason to believe that regional analyses would affect our analyses or conclusions.

We disagree with the assertion that we failed to provide an explanation as to why we chose to analyze impacts at the statewide population level. This information is presented in Sections 1.15.3, 1.15.4, and 1.16.3, and within the impact analyses for individual target predator populations in Section 3.1.1. Further clarification of our reasoning was added to the Final EA in Section 1.16.2.

5.23 Special Management Areas.

We received several comments regarding PDM in Special Management Areas (SMAs), including Wilderness Areas (WAs) and Wilderness Study Areas (WSAs). Commenters opposed PDM in SMAs, or asserted that the EA fails to adequately consider potential impacts on SMAs. One commenter asserted that the EA should have included site-specific analyses for each SMA in Colorado. Other commenters asserted that WAs would be negatively impacted by the use of M-44 devices, which would pose a threat to humans and pets there.

We understand that some individuals will not agree with the use of PDM in special management areas (SMAs), such as Wilderness Areas (WAs) and Wilderness Study Areas (WSAs). We considered an alternative to not conduct PDM in WAs or WSAs in Section 2.10.24. This alternative was not considered in detail for the reasons provided therein. Alternative 1, which includes PDM in WAs, was analyzed in detail in Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1, and we determined that it would not result in any significant impact on the environment. This assessment includes SMAs such as WAs and WSAs in Section 3.5.1.4. In Section 3.7, we analyzed the ability of four alternatives to meet the goals and objectives of APHIS-WS and WS-Colorado, and Alternative 1 was determined to best accomplish these.

We disagree with the assertion that the EA fails to adequately consider potential impacts on SMAs under Alternative 1. We thoroughly discussed and analyzed the potential impacts to SMAs under Alternative 1 in Section 3.5.1.4, including Tables 3-21 and 3-22. This analysis included sensitive wildlife species found in the various SMAs (Table 3-22). In table 3-21, we provided a non-exhaustive list of many of the SMAs in Colorado, including 181 SMAs.

We disagree that the inclusion of site-specific analyses for all SMAs in Colorado would be reasonable. Due to the infrequent and sporadic nature of WS-Colorado's PDM work in SMAs, analyses for each SMA in Colorado would be uninformative. NEPA requires an analysis of the impacts by looking at the issues as implemented under each alternative. WS-Colorado conducts this analysis at the statewide level. If is redundant and adds nothing to the analysis to conduct the same analysis of the same issues and alternatives at a smaller scale because an analysis conducted at the statewide scale is more informative. Therefore to look at site-specific analyses for each of the 181 SMAs in Colorado is less informative than looking at the impacts statewide. In Section 3.5.1.4, we provided site-specific information for every SMA in which we conducted PDM during the analysis period of the EA.

It is a false assertion that WAs would be negatively impacted by the use of M-44 devices by WS-Colorado under Alternative 1. WS-Colorado does not use M-44 devices on public lands, as stated in Table 2-4; Sections 2.10.23, 2.11.2.6, 2.11.2.7, 3.4.1, 3.4.1.4, and 3.5.1; and in Appendix A. As such, there would be no potential for negative impacts to WAs from the use of M-44 devices, including impacts on humans and pets.

5.24 Wildlife Viewing and Ecotourism.

We received several comments regarding wildlife viewing and ecotourism. Commenters asserted that wildlife viewing opportunities would be diminished under Alternative 1, and that the State of Colorado would lose ecotourism dollars due to diminished opportunities for wildlife viewing under Alternative 1. One commenter refers to $100 billion in economic activity due to wildlife watching on public lands (Leonard 2008), and asserts that these public lands are often where WS conducts lethal PDM.

We disagree with the assertion that Alternative 1 would result in decreased opportunities for wildlife viewing. We understand that many people appreciate wildlife viewing opportunities, as discussed in Section 2.2.5. We considered the impacts of Alternative 1 on wildlife viewing, including photography, in Section 3.5.1, and determined that there would be no significant impact. This analysis includes consideration of the presence and abundance of wildlife species available for viewing, which was analyzed in Sections 3.1.1 and 3.2.1, and determined to not result in any significant impact under Alternative 1. Any potential deficiencies within wildlife populations which might decrease opportunities for wildlife viewing are neither caused by nor contributed to by WS-Colorado, as analyzed and discussed in Sections 3.1.1, 3.2.1, and 3.5.1.

We disagree with this assertion that Alternative 1 will result in decreased income from ecotourism, based on the information and analysis provided throughout Section 3.5.1.

We have considered Leonard 2008. The amount of income generated by wildlife watching is outside the scope of the EA; as discussed and analyzed in Section 3.5.1, Alternative 1 would not result in any significant impacts on the use of public lands for recreation. This is supported by the analyses in Sections 3.1.1 and 3.2.1, which showed that Alternative 1 would not significantly impact wildlife populations. We disagree with the assertion that these recreation areas are often where WS-Colorado conducts lethal PDM. As discussed in Section 3.1.1.1 and 3.5.1, most WS-Colorado PDM is conducted on private lands. In addition, PDM conducted on public lands is not generally conducted in areas of recreation, including wildlife watching, as discussed in Section 3.5.1.

5.25 Other Comments and General Comments.

We received numerous other comments, including general comments and other comments which did not fit into the categories listed in the prior Sections of Chapter 5. These comments were either adequately addressed in the Draft EA which was published for public comment, or have been clarified in the Final EA. These comments are provided below in **bold** font. Responses specific to each comment are provided below each comment in plain text (*i.e.*, not bold).

5.25.1 The EA does not consider the true environmental baseline/no-action alternative.

We disagree with this assertion. The "no action" alternative is the Preferred Alternative (Alternative 1) for the reasons discussed in Section 2.6.1. We added a description of the "environmental baseline" to Section 1.16.4 in order to clarify the environmental baseline we used for the analyses in Chapter 3. We also clarified this in Section 3, stating that the proposed action/no action alternative (Alternative 1) was assessed against the environmental baseline, and that Alternative 1 was then used as the benchmark for comparisons among the Alternatives. In other words, Alternatives 2, 3, and 4 were compared to the proposed action (Alternative 1) for each issue to determine if real or potential impacts would be higher, lower, or approximately the same. We used this method of comparison because it is the most efficient and effective way to compare the alternatives, as stated in Section 3. If the commenter means that the "environmental baseline" should have been the "no WS-Colorado PDM Program" alternative, this is Alternative 4, which was analyzed in detail in Sections 3.1.4, 3.2.4, 3.3.4, 3.4.4, 3.5.4, and 3.6.4.

5.25.2 Reducing predator populations will result in increased problems caused by predators.

We are not aware of any credible data or research which would support this assertion, and the commenter does not provide any citations. In most cases, WS-Colorado PDM would not reduce predator populations, except temporarily in small site-specific locations, as discussed in Section 1.11.2 and 2.6.9.4.

5.25.3 EA does not consider cumulative impacts by making conclusory statements without analysis of: gas and oil development, timber harvesting, land development, and

grazing. These actions were dismissed because WS has "no authority to affect determinations of other entities," but this is arbitrary and capricious.

We disagree that our analysis and/or decisions regarding these activities were arbitrary and capricious. The potential cumulative impacts of oil and gas development, timber harvesting, and grazing were discussed thoroughly in Section 2.3.3, where we also noted that "WS-Colorado has no authority to affect decisions of other entities," and "they are not related or connected to WS-Colorado actions."

5.25.4 Impacts from livestock grazing on public lands are "cumulative and similar" impacts, and these impacts must be included in the EA.

We disagree with this assertion. This issue was discussed in Section 2.3.3, as well as in Sections 1.12 and 1.19.6.1.

5.25.5 Young predators will be orphaned when adults are lethally removed.

The potential for young predators to become orphaned by the lethal removal of the adults under Alternative 1 was addressed in Section 3.6.1.1. This is challenging in that how do you limit suffering and to whom. The choice would be to limit suffering of the wild animal that may become an orphan or limit suffering of the livestock being killed by the wild predators. Until better methods and strategies are developed that limit suffering there is no good choice that eliminates all suffering.

5.25.6 The EA cites contradictory levels of potential mountain lion take on pages 137 and 138, citing potential take "up to 36%" and 53%. The CPW study plan cites take up to 50%. This is proof that WS did not adequately consider the environmental impacts of its proposed action, and that it failed to allow the public to meaningfully comment.

We disagree with the assertions that the percentages included in Section 3.1.1.6 were contradictory, that this prevented the public from the ability to meaningfully comment on the EA, and that we did not consider the environmental impacts of Alternative 1. We provided accurate and consistent information in Section 3.1.1.6. We have further clarified the meaning of the percentages provided in Section 3.1.1.6 in order to prevent further confusion. The potential for impacts on the mountain lion population was adequately analyzed in Section 3.1.1.6.

5.25.7 The EA states that impacts on the statewide mountain lion population "is likely to be low, but could be higher." The EA states that take of 50% of local populations "would be considered moderate impact," but would be expected to rebound within three years. There is no explanation, methodology, or source for why the agency is apparently dismissing these potentially significant impacts.

We disagree that the EA does not provide "explanation, methodology, or source". The EA provided the following explanation for the statements in Section 3.1.1.6: "however, these populations would be expected to recover within three years (Logan *et al.* 1996)." The source is supplied in the EA immediately following the statement. Moreover, in both cases, these summary statements followed the preceding analysis in Section 3.1.1.6, which included explanations and sources (citations to scientific literature).

5.25.8 WS-Colorado's take of other animals, including prairie dogs, beavers and birds, must be included as "cumulative, connected, and related impacts."

WS-Colorado's take of these other species is considered in separate NEPA analyses, as discussed in Section 1.16.2. The analyses in this EA include total predator take by WS-Colorado, including any potential non-target take under these other NEPA analyses. These other NEPA analyses include all non-target take which might have occurred during PDM as connected actions.

5.25.9 The potential to capture a T/E species requires the preparation of an EIS.

This is a false assertion. Moreover, WS-Colorado is unlikely to capture any threatened or endangered species under Alternative 1, as discussed in Section 3.2.1.1, and Appendices C and D.

5.25.10 The EA makes several conclusory statements without any analysis, methodologies, or sources. Example: on page 152 the EA states that although the proposed action may result in short-term impacts to localized carnivore populations, it does not consider these impacts to be "significant", because they are localized and temporary. However, NEPA requires consideration of local and short-term impacts. WS provides no explanation as to how it reached this conclusion.

This is a false assertion. The statement referenced in Section 3.1.1.20 is a summary statement in this summary section, entitled "Summary of Direct, Indirect, and Cumulative Impacts to target wildlife populations Under Alternative 1." The analyses are conducted in the Sections for each of the species mentioned in the statement referenced by the commenter: Sections 3.1.1.1 (coyote), 3.1.1.5 (black bear), and 3.1.1.6 (mountain lion).

5.25.11 CPW and WS-Colorado do not have site-specific mountain lion population data, so the assessment of a "moderate" impact on mountain lions in local areas is a guess.

CPW manages mountain lion populations by DAUs. The assessment of short-term, moderate impacts to some localized populations is based on CPW estimates within these DAUs. This topic is discussed in Section 3.1.1.6.

5.25.12 The EA provides no discussion of whether other parties have the resources or authority to conduct lethal PDM in the same manner and extent as WS-Colorado.

This is a false assertion. The potential for other entities to conduct PMD in the absence of PDM conducted by WS-Colorado was discussed in Sections 2.6.6, and 2.6.11; in Table 2-4; and throughout Chapter 3.

5.25.13 The EA represents the CPW predator research projects as the "continuation of the status quo", but these activities are a sharp departure from activities carried out in the past by WS-Colorado.

We disagree with this assertion. WS-Colorado's involvement in PDM projects to protect natural resources, or to study the effects of predation on natural resources, is sporadic, as discussed in Sections 1.17.5 and 2.6.9. These activities are aligned with the goals and objectives of WS-Colorado, as discussed in Section 1.2, 1.5, 1.11, and 1.11.2.

5.25.14 WS-Colorado did not complete a sufficient NEPA analysis of the CPW predator studies. The fact that the predator studies are conducted by CPW does not absolve WS-Colorado from engaging in an analysis of the environmental impacts of those studies.

We disagree with the assertion that WS-Colorado did not complete a sufficient NEPA analysis of the CPW predator studies. The EA contains our analysis of the environmental impacts of the Continuation of the WS-Colorado PDM Program (Alternative 1) in Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1. These analyses include the proposed PDM which might be conducted by WS-Colorado for the CPW predation studies in Appendices G and H.

5.25.15 WS-Colorado irreparably prejudices its analysis of the CPW predator studies by taking part in them in 2017.

We disagree. It is unclear why the commenter believes that taking part in the CPW predation studies (Appendices G and H) might "irreparably prejudice" our analyses in the EA.

5.25.16 WS-Colorado has decision-making power over the CPW predator studies because it decides whether or not to participate.

This is a false assertion. WS-Colorado does not have decision-making authority over the CPW predation studies reference in Section 2.6.9.4 and in Appendices G and H.

5.25.17 Black bears are vegetarians to a great extent, and they do not kill deer to eat.

As discussed in the EA in Section 3.1.1.5, black bears eat a variety of foods, and they may "be a more efficient predator of large game and livestock than was previously believed." Damage caused by black bears, including livestock depredation was also discussed throughout Section 1.16, and especially in Section 1.16.1 and 1.16.2.5. Section 2.6.9.4 specifically addresses black bear predation on deer.

5.25.18 If the CPW research is effective in increasing ungulate survival, this is an environmental impact, and the EA avoids this issue entirely.

We disagree with this assertion. If the CPW research finds increased ungulate survival, this would be a benefit to the environment, because the mule deer population is considerably below CPW's target range, as discussed in Section 1.17.5.4. As discussed in Sections 1.11.4, 1.12, 1.13, 1.16.3, 3.1.1.5 and 3.1.1.6, CPW has management authority over the management of most wildlife species in Colorado, and the decision of CPW to effect a change in the population of any species which it manages would not necessarily be considered a significant impact (Sections 1.16.3, 3.1.1.5, and 3.1.1.6). An increase or decrease in a wildlife population is not necessarily a significant impact. In order to be considered significant, the magnitude of the population change must be substantial, such as a change which results in the population being unable to sustain itself, major changes to other species populations, major alterations in ecosystem function, or other significant impacts on the quality of the human environment, as discussed in Section 1.16.3.

5.25.19 WS-Colorado provides lethal PDM "for free", which "incentivizes ranchers to not take actions to prevent predation.

We disagree with the assertion that providing PDM services incentivizes ranchers to not take action. This assertion is not logical because failing to take actions to prevent predation would result in economic losses to those producers. Most producers who request WS-Colorado PDM assistance have already used several non-lethal methods, as discussed in EA in Section 1.17.2.6. We also disagree with the assertion that PDM services are provided "for free." The PDM services provided by WS-Colorado are all cost-share based; no services are provided for free, as noted in the EA in Section 2.10.2.

5.25.20 Is opposed to the destruction of wildlife habitat.

WS-Colorado activities under the Preferred Alternative would not destroy or contribute to the destruction of any wildlife habitat directly or indirectly, as discussed in Sections 1.16.5.3, 2.3.3, 2.4, and 3.5.1.4.

5.25.21 The EA did not analyze adverse opinions on trophic cascades or mesopredator release in sufficient detail. Adverse ecosystem effects can begin to occur before the eradication of a species, and the EA presents no evidence otherwise.

We disagree with this assertion. We analyzed and discussed these topics in detail in Sections 3.2.1.1, 3.3, and 3.3.1.2 of the EA, including numerous dissenting opinions.

5.25.22 Trophic cascades occur in the absence of apex predators.

Trophic cascades were discussed in Section 3.3, and the potential for Alternative 1 to result in trophic cascades was analyzed in Section 3.3.1.2.

5.25.23 WS-Colorado should educate people with factual information regarding predators.

We agree that WS-Colorado should educate people with factual information regarding predators. This is why we provide such factual information, as stated in Sections 1.2, 1.11.2, 1.14.4.1, 1.17.1, and 2.6.4, and Appendix A.

5.25.24 The science is abundantly clear that we are experiencing an extinction crisis because of human forces that involves the large-scale killing, including by Wildlife Services' predator-control agents." Cites Ripple *et al.* 2016, Darimont *et al.* 2015, Ripple *et al.* 2014, and Estes *et al.* 2011.

We disagree with the implication that WS-Colorado actions contribute to wildlife extinctions. Our analyses in Sections 3.1.1, 3.1.2, and 3.1.3 determined that Alternative 1, the continuation of the WS-Colorado PDM Program, would not impact wildlife populations or ecosystem function. We reviewed Estes *et al.* 2011 during the preparation of the EA, and cited it as a reference. Darimont *et al.* 2015 was considered during the preparation of the EA. We did not cite this article because it did not add substantively to the information or analysis in the EA. We considered the content of Ripple *et al.* 2014. This article does not add substantively to the information or analyses in the EA. We considered the content of Ripple *et al.* 2016; it did not add substantively to the analyses in the EA (it is an opinion piece which does not present any primary scientific research).

5.25.25 WS fails to meet its mission "to provide federal leadership…to allow people and wildlife to coexist."

We disagree. The commenter does not include any specifics, so it is unclear in what specific way the commenter believes that WS-Colorado is failing to meet its mission.

5.25.26 The EA should have more input from wildlife biologists and PDM researchers.

The EA was written by wildlife biologists, with input from PDM researchers. Moreover, WS-Colorado PDM under Alternative 1 would be conducted under the direction of professional wildlife biologists.

5.25.27 Why are some animals are targeted and not others?

As discussed throughout Section 1.17, the need for PDM involves various predator species to varying degrees. The different species are targeted based on the damage they cause, or would be expected to cause if PDM was not conducted. Regarding individual animals, WS-Colorado generally targets the offending animals which are causing the problems, as discussed in Sections 1.2, 1.5.1, 1.5.2, 1.11.2, 1.11.4, 1.17.4, 1.18.3, 1.19.2, 2.6.3, 2.10.15, 2.10.19, 2.11.2.1, 3.2.1.4, 3.6.1.1, and 3.7.2. Regarding the use of lethal PDM versus non-lethal PDM, animals targeted for lethal PDM are those which have been shown to be refractory to non-lethal methods; WS-Colorado considers non-lethal methods first, as discussed in Sections 1.2, 1.11.3, 1.17.1, 1.17.2.6, 2.6.6, 2.10.4, and 2.10.6.

5.25.28 The EA states that increasing human-bear conflicts is, at least in part, our basis for asserting increasing black bear population in Colorado. Disagrees with this assertion, and refers to research by Heather Johnson of CPW, which reportedly contradicts the assertion.

This is a false assertion. We made no such statement or inference in the EA.

5.25.29 The black bear population in Colorado is not increasing.

The information presented in Section 3.1.1.5 and elsewhere refutes this assertion.

5.25.30 Black bears do not breed until 4-5 years (Beston 2011), and give birth to 2-3 cubs in Colorado (cite Beck 1991). These publications challenge data presented in the EA that black bears breed at 3.5 years and have 1-5 young.

We agree that Beston 2011 provides useful information regarding the age at which black bears first breed. We have included this citation as well as this age of first breeding for black bears in Section 3.1.1.5 of the EA. The 2-3 young reportedly found in Beck 1991 is not substantially different from the 1-5 young which we included in Section 3.1.1.5. The information in these references does not alter our analysis of potential impacts on black bear populations under the various alternatives.

5.25.31 The definition of biological carrying capacity demonstrates WS-Colorado's bias toward consumptive uses for wildlife, because the cited definition is from TWS.

We disagree with the assumption that TWS is inherently biased. We are not aware of any controversy between consumptive and non-consumptive users regarding the definition of "biological carrying capacity". We believe that the TWS definition of this term in Section 1.7 is objective and appropriate for information purposes.

5.25.32 The EA calls a 10% suppression of mountain lions "unsuppressed", which is confusing and misleading to the public.

This is a false assertion. The reportedly confusing language is that provided by the commenter in their interpretation of the CPW study plan provided in Appendix H of the EA. WS-Colorado did not include this language in the EA.

5.25.33 The EA makes bold, unsupported statements, such as "[o]ne of the biggest threats to public safety is attacks on people by large predators." This is without merit, and inflammatory rhetoric which seeks to affect the public's emotions and steer them and WS away from scientific analysis.

This is a false assertion. This quote from Section 1.16.4 of the Draft EA, taken out of context, might be misconstrued as a bold and unsupported statement, as asserted by the commenter. The intent of this statement, within the proper context of the preceding and subsequent sentences, is that "of the threats that predators pose to public health and safety, attacks on people by large predators are one of the biggest." The wording in the Final EA has been updated in Section 1.17.4 to better reflect this meaning, and to discourage any further misinterpretation. The assertion by the commenter that the intent of the statement was to "affect the public's emotions and steer them and Wildlife Services away from scientific analysis" is false. WS-Colorado's intent was to impart the information stated above. WS-Colorado has no intent of steering itself or the public away from scientific analysis.

5.25.34 WS-Colorado must not tier the EA to the 1997 Nationwide Programmatic EIS per WS' court-enforceable settlement agreement.

We have not tiered to the 1997 Programmatic EIS.

5.25.35 The degradation of recreation due to aerial PDM is quickly dismissed without proper analysis.

This is a false assertion. The potential for aerial PDM to impact recreation on public lands was discussed and analyzed in detail throughout Section 3.5.1, including Tables 3-16, 3-17, 3-18, 3-19, 3-20, and 3-21, and Appendix B.

5.25.36 The EA misrepresents the findings of Treves *et al.* 2013.

We disagree with this assertion. We believe that our assessment of the findings of Treves *et al.* 2013 included in Section 2.2.6.2 is accurate.

5.25.37 The EA misrepresents the content of Forrester and Wittmer 2013.

We disagree with this assertion. We believe that our assessment of the findings of Forrester and Wittmer 2013 included in Section 1.16.5.3 is accurate.

5.25.38 WS-Colorado's 2017 PDM EA was deficient.

This is a false statement. The 2017 WS-Colorado PDM EA (WS 2017a) is thorough, complete, in compliance with NEPA and CEQ regulations, and uses the best available science. This 2018 EA was prepared for the reasons discussed in Section 1.2, 1.15.2, and 1.16.1, not because of any deficiency in the 2017 PDM EA.

5.25.39 WS-Colorado adamantly supports public lands grazing.

This is a false assertion. WS-Colorado takes no official stance on public lands grazing.

5.25.40 WS is choosing to benefit the hunting community over the wildlife-watching community.

This is a false assertion. This topic was discussed in Section 2.3.1, including the reasons we did not analyze this issue in detail. As stated therein, WS-Colorado may provide PDM to benefit hunters or recreation, based on requests from an agency or tribe. However, WS-Colorado has not received any such requests recently, and is therefore not currently conducting any such PDM.

5.25.41 WS-Colorado does not have enough data to adequately determine impacts, nor to demonstrate the need.

We disagree with these assertions. The potential impact of the Preferred Action (Alternative 1) on the quality of the human environment was discussed and analyzed in Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1, and it was determined to have no significant impact. The need for PDM in Colorado was discussed exhaustively throughout Section 1.17.

5.25.42 The EA fails to consider that ranchers may purposefully allow livestock to be killed by predators in order to have carnivores killed. Cites Dougherty 2007, High Country News, Last Chance for the Lobo.

Consideration of this topic would not be reasonable. We are not aware of any reliable information which would suggest that such a phenomenon would add substantively to the information and analyses in the EA. The cited document, Dougherty 2007, is a newspaper article, which does not contain any actionable information regarding PDM in Colorado.

5.25.43 Research has proven that Lethal PDM will increase coyote populations.

We disagree with this assertion. We are not aware of any credible information or research which suggests that lethal PDM would increase coyote populations. As discussed in the EA in Sections 2.3.2, 2.3.9, and 3.1.1.1, coyotes are known to increase fecundity in response to removal; however, this increased fecundity has not been shown to result in increased coyote populations.

5.25.44 The population estimates for the target predator species fail to acknowledge the geographic diversity of the State of Colorado in determining population estimates.

This is a false assertion. The population estimates for target predator species throughout Section 3.1.1 address the geographic diversity of Colorado.

5.25.45 WS-Colorado seeks to expand lethal PDM to protect a variety of highly numerous or overpopulated game species, including elk, mule deer, and pronghorn antelope. This

represents a serious expansion of WS-Colorado's proposed activities, which was not addressed in the EA.

We disagree. WS-Colorado's involvement in PDM projects to protect natural resources, or to study the effects of predation on natural resources, is sporadic, as evidenced by the discussion throughout Section 2.6.9. These activities are aligned with the goals and objectives of WS-Colorado, as discussed in Section 1.2, 1.5, 1.11, and 1.11.2.

5.25.46 The EA is too long.

We did our best to be concise and direct, and to limit the length of the EA. Based on NEPA case law, APHIS requires the inclusion of various information and analysis in our EA, and we follow these requirements.

5.25.47 Is opposed to aerial PDM.

We understand that not all individuals will agree with all methods used by WS-Colorado for PDM. Aerial PDM is one of the most effective, cost-effective, and selective methods used by WS-Colorado for PDM, especially preventive PDM as discussed in the EA (*e.g.*, Section 3.1.2). Whereas there is some risk to employee safety when using this method, APHIS-WS and WS-Colorado have minimized that risk (Section 3.4.1). Aerial PDM is the primary tool used for preventive PDM for coyotes. If WS-Colorado chose not to use this tool, the outcome would be essentially the same as that for Alternative 2. Our analysis determined that this Alternative would not accomplish the goals and objectives of the Program as well as Alternative 1 (Section 3.7.2), whereas "the impact of direct, indirect, and cumulative take under Alternative 2 would be the same as those under Alternative 1" (Section 3.1.2).

5.25.48 Explosives and pyrotechnics will be used by WS-Colorado under Alternative 1 as lethal PDM methods, and is concerned about the harm these would cause to the public and the environment.

This is a false assertion. WS-Colorado does not use explosives or pyrotechnics as lethal methods of PDM, as discussed in the EA in Section 2.6.6 and Appendix A.

5.25.49 WS leaves carcasses laced with toxic chemicals in the environment as a means of lethal PDM.

This is a false assertion. This method is not included in the EA because WS-Colorado does not employ this method of PDM.

5.25.50 The EA is biased toward lethal PDM, glossing over copious research showing that non-lethal methods are effective, and that the environmental impacts of lethal PDM are much greater than previously known.

We disagree with these assertions. WS-Colorado considers, implements, and recommends numerous nonlethal PDM methods, as discussed in Sections 2.6.5, 2.6.6, and 2.10.6, and Appendix A. WS-Colorado employs an integrated predator damage management approach to resolve conflicts with mammalian predators, as discussed in Section 1.10 and elsewhere throughout the EA. This approach involves the use of a variety of nonlethal and lethal methods appropriate to the situation, as discussed in Sections 1.9, 1.11, 2.6, and Appendix A. The nonlethal methods used and recommended by WS-Colorado are used or recommended precisely because they are expected to be effective (Sections 2.6 and Appendix A). As discussed in Sections 1.11.3 and 2.10.6, WS-Colorado gives preference to the use of non-lethal methods over lethal methods whenever they are practical and effective. We are not aware of any cogent information to support the assertion that the environmental impacts of lethal PDM are much greater than previously known. The commenter does not provide any examples of such research.

5.25.51 Is opposed to Preventive PDM.

Preventive PDM is described and defined in Section 2.6.5. Section 2.7 describes Alternative 2 -- Lethal PDM Methods Used by WS-Colorado Only for Corrective Control. As discussed in Section 3.1.2, the impacts under Alternative 2, preventive PDM is used by the current WS-Colorado PDM program for coyote damage management "because some coyote damage is predictable based on prior damage and/or the appropriate conditions for damage." In this same Section, we also noted that "[e]ven with preventive nonlethal methods in use, preventive PDM has been shown to reduce sheep and lamb losses later in the year, compared to site without (Gantz 1990, Wagner and Conover 1999)." We are not aware of any more recent publications with data to suggest otherwise. We understand that some individuals will object to preventive PDM, which is why we included Alternative 2 (Lethal PDM Methods Used by WS-Colorado Only for Corrective Control) for detailed analysis. However, our analysis determined that this Alternative would not accomplish the goals and objectives of the Program as well as Alternative 1 (Section 3.7.2), whereas "the impact of direct, indirect, and cumulative take under Alternative 2 would be the same as those under Alternative 1" (Section 3.1.2).

5.25.52 The EA "fails to contemplate that large-bodied carnivores are sparsely populated across vast areas, invest in few offspring, provide extended parental care to their young, have a tendency toward infanticide, and limit reproduction, and in light of these biological factors, they rely on social stability to maintain resiliency". Cites Weaver *et al.* 1996 and Wallach *et al.* 2015.

This is a false assertion. This is addressed in Section 3.1.1.6, including numerous citations therein.

5.25.53 Mountain lions and wolves save far more people per year from death (5 per year) and injury (680 per year) by reducing vehicle collisions with deer, according to Gilbert *et al.* (2016).

We disagree with this assertion. Gilbert *et al.* (2016) studied collisions with white-tailed deer in the eastern United States. Their conclusions are not applicable to mule deer in Colorado. Moreover, the analysis of Gilbert *et al.* (2016) is faulty because it makes several assumptions, including that mountain lion predation would be additive.

5.25.54 Mountain lions are a self-regulating species. PDM and hunting are not necessary, according to Wallach *et al.* (2015).

Hunting of mountain lions is outside the scope of the EA, as discussed in the EA in Section 2.10.11. We disagree that there is no need for PDM for damage caused by mountain lions, as discussed in the EA throughout Section 1.17, and in Section 3.1.1.6. Wallach *et al.* (2015) assess "self-regulation" in apex predators, but this does not imply that there is no need for PDM.

5.25.55 Mountain lions are integral parts of their ecosystem; they are a keystone species, they regulate many other species including herbivores, who then regulate the plant community, according to Allen *et al.* (2014), Elbroch *et al.* (2014), and Soule *et al.* (2003).

We agree that mountain lions, and other native predators, are an integral part of the ecosystem, as discussed in Section 1.4. We disagree with the rest of this assertion. This topic is thoroughly discussed throughout Sections 3.3, 3.3.1.1, 3.3.1.2, and 3.3.1.3. We considered the content of Allen *et al.* (2014), Elbroch *et al.* (2014), and Soule *et al.* (2003). These documents do not add substantively to the information and analyses in the EA.

5.25.56 PDM and hunting harms entire communities of mountain lions by causing social chaos, according to Elbroch *et al.* (2017), Lambert *et al.* (2006), Cooley *et al.* (2009),

Robinson and Desimone (2011), Wielgus *et al.* (2013), Robinson *et al.* (2014), Ausband *et al.* (2015), Creel *et al.* (2015), and Darimont *et al.* (2015).

We disagree with this assertion. This topic was discussed in Section 3.1.1.6.

5.25.57 The EA fails to consider indirect impacts due to the removal of mountain lions in the CPW study areas, including: (1) increased intraspecific predation on females and kittens (Stoner *et al.* 2013, Wielgus *et al.* 2013); (2) inability to recruit new members of the population when too many adult females are removed (Anderson and Lindzey 2005); (3) death of adult females ensures the death of orphaned kittens by dehydration and malnutrition, even those at least 6-months old (Stoner *et al.* 2006, Elbroch and Quigley 2012). These factors will result in higher numbers of lions killed than just those targeted.

We disagree with this assertion. All of these factors were discussed in the EA in Section 3.1.1.6.

5.25.58 Wild canid populations will increase in response to lethal PDM.

We disagree with this assertion. The potential impacts on wild canid populations under Alternative 1 were discussed and analyzed in the EA in Sections 3.1.1, 3.2.1, and 3.3.1. We determined that there would be no significant impacts.

5.25.59 Chronic stress harms animals, according to Bonier *et al.* (2004), and Bonier *et al.* (2006).

WS-Colorado agrees that chronic stress can be harmful to animals. This issue was considered in detail in the EA in Section 3.2.1.4 through 3.2.1.8, where it was determined that WS-Colorado PDM activities under Alternative 1 would not result in chronic stress to any wildlife species. This includes direct, indirect, and cumulative impacts.

5.25.60 In February 2017, the Journal of Mammalogy devoted an entire issue on predator control and co-existence, but WS-Colorado did not consider any of these salient and relevant topics.

This is a false assertion. The Journal of Mammalogy did not devote the entire issue to this topic. This issue included a special topic on lethal control of predators, including 6 of the 11 articles in the issue. We have considered the articles included in this special topic. They do not add substantively to the information and analyses in the EA. Five of these articles have been addressed in other responses, because they were either sent to us, or cited in a comment, or both. The only other article (Vucetich *et al.* 2017) is about wolf hunting in Michigan, and is not applicable to the content of the EA.

5.25.61 Loss *et al.* 2012 (or 2013) provide useful data on the damage to wildlife caused by feral cats.

We appreciate the reference. This has been incorporated into the EA.

5.25.62 Cites Santiago-Avila *et al.* 2018

We have considered the content of this article. It does not add substantively to the information and analyses in the EA. This is about lethal wolf control, which is outside the scope of the EA.

5.25.63 Pets and livestock can easily be replaced; there is an overabundance of them.

A determination of the proper number of pets and livestock in the United States, or in Colorado, is outside the scope of this EA. Whether or not pets and livestock can easily be replaced is also outside the scope of this EA.

5.25.64 Wants information on how each listed predator interacts with the larger environment and impacts other species.

A discussion of all of these interactions is outside the scope of the EA. Information on each target predator species is provided throughout Section 3.1.1, including references which contain more detailed information about these species. Information on the importance of predators to their ecosystems, including the ecosystem services they provide, is discussed or referenced in Sections 1.4, 1.9, 1.11, 1.11.2, 1.11.3, 2.6.2, 2.10.15, 2.11, 3.3, and 3.3.1.3. These references demonstrate the importance of predaors to their environment, and to other species in the environment. The discussions in Chapter 3 are especially demonstrative of this. We included additional information in Section 1.4 of the Final EA in order to clarify our understanding of this topic, and better inform readers.

5.25.65 Livestock grazing should not be allowed on public lands.

Whether or not grazing is allowed on public lands is outside the scope of this EA, because the decision whether to allow cattle grazing on public lands in the United States is not within the authority of APHIS-WS or WS-Colorado, as discussed in Sections 1.12, 1.19.6.1, 1.19.6.5, and 2.3.5.

5.25.66 WS-Colorado must adopt a 24-hour trap-check period; this in an ethical baseline.

We disagree with the assertion that WS-Colorado must adopt a 24-hour trap-check period. As stated throughout the EA (including Section 1.10.2), WS-Colorado follows state laws. This includes laws regarding trap-check intervals (Appendix A). We also disagree with the assertion that a 24-hour trap-check period is an ethical baseline. We understand that some individuals would prefer this approach. We analyzed the humaneness of Alternative 1 in Section 3.6.1.1. We also analyzed humaneness under Alternative 1 indirectly in Sections 3.2.1 and 3.4.1; the selectivity of WS-Colorado PDM reflects the humaneness of our methods.

5.25.67 "[K]illing off the wolf allowed CWD to take hold in the first place." Quote from 2003 Denver Post article by Theo Stein.

We are not aware of any credible information which would support this assertion. The impacts of the extirpation of wolves early in the 20th century are also outside the scope of the EA.

5.25.68 The EA provides percentages of livestock protected by nonlethal methods without necessary details, including: whether one rancher uses more than one method, and how many total ranchers are employing non-lethal methods compared to the total number of ranchers. This renders the data utterly useless to both the public and WS-Colorado.

The assertion that the EA provides "percentages of livestock protected by non-lethal methods" is false. Ostensibly, the commenter is referring mistakenly to the date in Table 1-7 in Section 1.17.2.6, which provides NASS data on non-lethal methods used by Colorado livestock operations. These data refer to the percentage of livestock producers, not the number of livestock. The assertion that the data do not include "whether one rancher uses more than one method" is false. As stated in the title of Table 1-7 in Section 1.17.2.6, "Producers can utilize more than one non-lethal method simultaneously." The assertion that the presented data do not show "how many total ranchers are employing non-lethal methods compared to the total number of ranchers" is false. Table 1-7 in Section 1.17.2.6 includes percentages of ranchers employing these methods. We disagree with the assertion that the data are "utterly useless". The data provide the precise information which the commenter refers to as "necessary details".

5.25.69 Is opposed to implementation of Alternative 1 without study and consideration of impacts on the environment.

This EA provides consideration and analysis of potential impacts on the environment under Alternative 1, using the best available science and information (Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, 3.6.1, and 3.8). These analyses determined that there would be no significant environmental impact under Alternative 1.

5.25.70 Is opposed to increased predator take in Colorado.

We understand that not all individuals will agree with all of the proposed actions under Alternative 1. The only substantial increase in predator take by WS-Colorado considered in the EA is a potential increase in the take of black bears due to increases in livestock depredation, and our participation in the CPW predator research in the Piceance Basin, as discussed in Sections 2.6.9.4 and 3.1.1.5.

5.25.71 Is opposed to the destruction of wildlife habitat and ecosystems, and the introduction of non-native plants and animals.

We disagree with the implication that Alternative 1 would result in or add to any destruction of wildlife habitat or ecosystems, or any introduction of non-native plants or animals. The potential for the Alternative 1 to impact ecosystems or any other environmental factor was analyzed in Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1. We determined in these Sections that Alternative 1 would not result in any significant impact on the environment, including ecosystems. Wildlife habitat is not impacted by WS-Colorado actions, as discussed in Section 2.4. The EA does not propose to introduce any non-native plants or animals under the Preferred Alternative, or any alternative.

5.25.72 WS-Colorado's rationale that their use of lead ammunition is miniscule compared to other sources of lead ammunition is inadequate and unsupported by science. Lead is harmful to the environment.

We disagree with these assertions. Our analysis of the potential impacts to the environment from the use of lead ammunition under Alternative 1 was not limited to the amount of lead ammunition used by WS-Colorado; Sections 3.2.1.2, 3.2.1.3, and 3.4.1.3 contain thorough analyses of this issue. We used the best available science and information to conduct our analysis, and determined that the use of lead ammunition by WS-Colorado would not result in a significant impact on the environment for the reasons discussed in Sections 3.2.1.2, 3.2.1.3, and 3.4.1.3.

5.25.73 Are there more ungulates for hunters to harvest due to PDM to protect livestock? How much money or benefit does a county get from big game hunting?

It is difficult to answer either of these questions with any certainty. The first question is more pertinent to the EA. The answer to this question depends on whether the removed predators would have resulted in additive or compensatory mortality in the big game prey species of interest. This is discussed in Section 1.17.5.10. Unfortunately, this is very difficult to know. CPW is currently conducting research to determine the impacts of predation on mule deer demographics, as discussed in Section 2.6.9.4 and Appendices G, H, and I. The results of these studies might not be applicable to other areas. A thorough discussion of this topic is presented in Sections 1.17.5 and 2.6.9.4.

5.25.74 How many deer stay alive for each coyote lethally removed by WS-Colorado?

It is difficult to answer this questions with any certainty. The answer depends on whether the removed predators would have resulted in additive or compensatory mortality in deer. This is discussed in Section 1.17.5.10. Unfortunately, this is very difficult to know. CPW is currently conducting research to determine the impacts of predation on mule deer demographics, as discussed in Section 2.6.9.4 and Appendices G, H, and I. The results of these studies might not be applicable to other areas. A thorough discussion of this topic is presented in Sections 1.17.5 and 2.6.9.4.

5.25.75 Alternative 1 will result in the purposeful killing of pets with firearms.

We are not aware of any credible information to support this assertion. This was not included as a potential indirect impact under Alternative 1 because this is not a reasonably foreseeable result. It is extremely unlikely.

5.25.76 Native carnivores are finally returning to Colorado after decades of efforts to eradicate them, and that their return is bringing back ecosystem balance.

These are false assertions. We are not aware of any efforts to eradicate predators from Colorado in recent decades. We are also not aware of any declines in predator populations which are being reversed recently, or any impacts associated with such.

5.25.77 Predator populations in Colorado are low.

We disagree with this generic assertion. Many native predator species are very common in Colorado, as discussed in Section 3.1.1. CPW estimates suggest an increasing black bear population (Section 1.16.2). Also, CPW manages mountain lion populations to be at or near carrying capacity as discussed in Section 3.1.1.6. CPW reports cited in the EA have not raised such concerns about any predator species in Colorado discussed in this EA. We are not aware of any data or research which would support this assertion. Some predator species populations, such as Canada lynx, are indeed low because they are specialist with specific habitat and food requirements which limits lynx abundance, as discussed in Section 3.2.1.

5.25.78 Wants information on current animal populations in Colorado.

Estimated target predator populations in Colorado are provided in Section 3.1.1. Recent estimated deer, elk, and pronghorn populations from CPW are provided in Section 3.2.1.

5.25.79 There should be more public input in the process, via news stations for example.

WS-Colorado exceeded the requirements for public input on this EA.

5.25.80 Ranchers are reimbursed for livestock losses due to predators, including wolves.

The State of Colorado reimburses producers for livestock losses due to black bears and mountain lions only. Losses due to other predators, including coyotes, are not compensated. This is discussed in Sections 1.19.6.2 and 2.10.9. The State of Colorado does not reimburse for wolf depredation. No extant wolf population is known to exist in Colorado. No wolf depredation on livestock has been documented by WS-Colorado in recent decades.

5.25.81 WS-Colorado should consider the following resources which were not considered: vegetation, soil composition, and the impacts of the loss of individual animals. Avers that the definition of ecology includes these factors, and they should be considered, even if more research is needed to assess the impact.

These resources were considered in Section 2.4, along with a discussion of the reasons we did not evaluate them in detail.

5.25.82 The EA wrongly asserts that grazing of livestock is included in the appropriate uses of WAs under Section 1133(b); grazing is instead listed as a "non-conforming use that detrimentally affects Wilderness" listed in Section 1133(c).

It is a false assertion that grazing is listed as a "non-conforming use that detrimentally affects Wilderness" in Section 1133(c) of The Wilderness Act. Grazing is addressed as a special provision in

The Wilderness Act at 16 USC 1133(d)(4). Discussions of The Wilderness Act are included in Sections 2.10.24, 2.11, and 3.5.1.4.

5.25.83 A wolverine was unintentionally killed in a trap by WS in 2010.

No wolverines have been taken by WS in Colorado. The potential take of a wolverine by APHIS-WS or any other entity outside of Colorado is outside the scope of this EA. This EA is specific to WS-Colorado PDM in Colorado, as discussed in Section 1.16.2.

5.25.84 WS has a poor track record of record-keeping regarding take of target and non-target species.

We disagree with this assertion, based on the information and analysis provided in Section 2.3.12.

5.25.85 Consultation with the USFWS regarding potential take of T&E species does not absolve WS-Colorado of its NEPA duties.

We analyzed the potential impacts to T&E species under Alternative 1 in Section 3.2.1.1.

5.25.86 WS-Colorado should eliminate trapping from its list of methods because this is the will of the people of Colorado.

This is a false interpretation of the will of the people of Colorado as it pertains to Amendment 14 to the Colorado Constitution. Amendment 14 includes provisions for the use of foothold traps to protect agriculture, human health and safety, as well as for research. WS-Colorado complies with all state laws, including the regulations enacted pursuant to the passage of Amendment 14 to the Colorado Constitution.

5.25.87 WS-Colorado must conduct a new consultation with the USFWS on the impacts of its proposal on a variety of listed species.

We disagree with this assertion. WS-Colorado consulted with the USFWS in 2016 regarding the potential impacts to federal listed threatened or endangered species from the WS-Colorado WDM Program, including the WS-Colorado PDM Program considered and analyzed in the EA, as referenced in Section 3.2.1.1, and Appendices C and D. This consultation is current and valid.

5.25.88 To comply with NEPA, work-planning meetings with land management agencies must include public involvement if work is to be conducted on Special Management Areas.

This is a false assertion. Neither NEPA nor CEQ regulations regarding the implementation of NEPA require work-planning meetings to include public involvement. WS-Colorado is not required to involve the public in work planning meetings with other agencies or cooperators. APHIS NEPA Implementing Procedures describe the agencies requirements for involving the public in major planning and decision processes. The scope of work discussed in these work-planning meetings, and contained in the Animal Damage Management Plans (ADMs), is covered by the analyses in this EA, as discussed in Sections 1.14.1 and 1.15.3. These meetings and ADMs determine how the scope of work analyzed in this EA is to be conducted on those specific lands (Section 1.14.1). This includes work on Special Management Areas (SMAs), such as Wilderness Areas (WAs) and Wilderness Study Areas (WSAs)(Section 1.14.1). The potential impacts of WS-Colorado PDM on SMAs, including WAs and WSAs, is analyzed in Section 3.5.1.4. Any work discussed or considered in work-planning meetings, or contained in ADMs, would be within the scope analyzed in Section 3.5.1.4, and elsewhere throughout this EA.

5.25.89 Why are requesters deemed able to implement non-lethal, while the EA also argues ranchers are not adequately trained to implement lethal?

This question was addressed in Sections 1.16.2.6, 1.17.2.2, 2.6.5, 2.6.6, 3.1.3, and 3.1.4.

5.25.90 Is opposed to all WS programs nationwide.

WS-Colorado recognizes that some individuals will oppose our actions. This EA covers WS-Colorado PDM actions within the state of Colorado. The actions of APHIS-WS outside of Colorado are not within the scope of this EA. The actions of WS-Colorado for purposes other than PDM are not within the scope of this EA. The proposed PDM actions of WS-Colorado were analyzed under the Preferred Alternative (Alternative 1) in the EA. Our analysis in the EA shows that this is the only alternative which can accomplish the goals and objectives of the Program (Section 3.7.1). Our analyses in the EA also show that this Alternative will not result in any significant impacts on the environment (Sections 3.1.1, 3.2.1, 3.3.1, 3.4.1, 3.5.1, and 3.6.1.

5.25.91 WS-Colorado claims that only a few offending animals are killed, and that no non-target animals are killed.

WS-Colorado acknowledges that although non-target take is rare, it can happen. Non-target take is analyzed in Section 3.2.1. WS-Colorado take of target predators and non-target animals during the analysis period of the EA is addressed in Sections 3.1.1 and 3.2.1.

5.25.92 Lethal PDM should be discontinued until "gold standard" reviews are completed, as suggested by Treves *et al.* 2016. More research is needed.

We disagree with this assertion, and with the assertions of Treves *et al.* 2016, for the reasons discussed in Sections 1.18.3, 2.10.28, and Appendix E. We discussed the effectiveness of APHIS-WS PDM Programs, including lethal PDM, in Section 1.18.2. The potential impacts of PDM were thoroughly discussed and analyzed throughout Chapter 3.

5.25.93 Most of the predators targeted under Alternative 1 are in the wild and not near farms.

This is a false assertion. Predators not near farms, livestock, or other human resources are generally not targeted by WS-Colorado because they are generally not causing damage. WS-Colorado targets the offending animals which are causing, or expect to cause damage, as discussed in Sections 1.2, 1.5.1, 1.5.2, 1.11.2, 1.11.4, 1.17.4, 1.18.3, 1.19.2, 2.6.3, 2.10.15, 2.10.19, 2.11.2.1, 3.2.1.4, 3.6.1.1, and 3.7.2.

5.25.94 What are the benefits to sage grouse populations from livestock protection programs?

The potential for PDM to protect sage-grouse was discussed in Section 1.17.5.8. The potential benefits to sage-grouse from livestock protection programs has not been assessed, so the potential for such benefits is unknown.

5.25.95 What benefit do state and counties get from WS-Colorado PDM?

The State of Colorado, and the counties within the State of Colorado, benefit from WS-Colorado PDM in several ways: (1) increased productivity in agriculture, which means higher tax incomes and higher quality of life for their constituents; (2) increased human safety due to decreased risk of injury or death from predator attacks; (3) increased human safety due to decreased risk of aircraft-wildlife collisions; (4) increased quality of life of residents due to decreased risk of pets being injured or killed by wildlife; and (5) increased ability to manage natural resources when predation has been identified as a risk factor.

5.25.96 What is the appropriate staffing level per county to protect livestock from predation?

This depends on the number and type of livestock protected in each county. We estimate that one WS-Colorado employee can protect approximately 10,000-24,000 sheep, depending on the level of services requested and the density of roads for access. This number decreases with increasing bear damage, because responding to bear damage is more labor-intensive. The amount of cattle which can be protected by one WS-Colorado employee is unknown.

5.25.97 What percent of livestock producers statewide and per county participate in WS-Colorado livestock protection programs?

Statewide, we estimate that approximately 25% of sheep producers and less than 5% of cattle producers participate in WS-Colorado livestock protection programs. We do not have these data by County.

5.25.98 WS is not transparent about the nature and cost of its activities. In 2011 four members of Congress asked for specific information on budget allocations. APHIS' response failed to provide significant information as requested, citing that of the $59 million spent on animal damage management, the portion spent on lethal predator control was unknown. Cites Campbell *et al.* 2011 and Parham 2011.

Sections 1.17 and 1.18 provides a thorough explanation of the difficulties associated with estimating the cost associated with PDM.

5.26 Documents Incorporated and Cited in the EA.

We received numerous documents attached to various comments. Many of these documents were already incorporated into the EA, and cited herein. These include:

Lute and Attari 2016
Peebles *et al.* 2013
Crooks *et al.* 1999
Forrester and Wittmer 2013
Henke and Bryant 1999
Wielgus *et al.* 2013
AVMA 2013
Ripple and Beschta 2012
Crooks and Soule 1999
Teel 2002
Coates *et al.* 2016
Ripple *et al.* 2014
Lindzey 1992
Lute and Attari 2016
Monteith 2014
Ballard *et al.* 2001
Ripple and Beschta 2006
Beschta *et al.* 2013
Treves *et al.* 2016
Estes *et al.* 2011
Lambert *et al.* 2006
NASS 2015
Berger 2006
Mitchell 2004
Prugh *et al.* 2009
Forrester 2013
Cooley 2009
George *et al.* 2016
Ripple *et al.* 2013
Vucetich 2005
Gese 2005
Bergstrom *et al.* 2014
Peebles *et al.* 2013
Parks and Messmer 2016

5.27 Documents Considered but Not Cited in the EA.

We received numerous documents attached to various comments. Many of these documents were already considered, but not cited in the EA. These include:

Darimont 2015, unique ecology of human predators
Carter and Linnell 2016, coexisting with large carnivores
Beausoleil *et al.* 2013,
Ripple and Beschta 2011, trophic cascades in Yellowstone
Bryan *et al.* 2014, hunted wolves have higher stress
Lance 2010, fladry for wolves
Beschta and Ripple 2016, riparian vegetation recovery in Yellowstone

Hristienko 2007, black bear management
Sponarski *et al.* 2015, role of cognition and emotions in human-coyote interactions
Andelt 1996, carnivore chapter
Smith *et al.* 2003, Yellowstone after wolves
Conner *et al.* 1998, effect of coyote removal on sheep depredation
Treves 2011, risk maps for predator attacks on livestock
Elbroch 2015, nowhere to hide
Cypher and Scrivner 1992, coyote control to protect endangered foxes
Davison-Nelson and Gehring 2010, fladry as a nonlethal tool for wolves and coyotes
Treves *et al.* 2015, predators and the public trust
Mezquida *et al.* 2006, implications of coyote control on sage-grouse populations.
Callan 2013, wolves, trophic cascade Wisconsin
Ripple *et al.* 2014, trophic cascades wolves grizzlies Yellowstone
Berger 2008, trophic cascades
Sacks 2002, coyote predation on sheep
Smith *et al.* 2003, Yellowstone after wolves
Gilbert 2016, ecosystem services of cougars
Logan 2014, puma population responses to hunting
Proulx 2015, bounties cause animal suffering
Andelt 1999, trapping
Logan *et al.* 1999, pumas foot-hold snares
Berger and Gese 2007, does competition with wolves limit coyotes

5.28 Documents Considered upon Receipt.

We received numerous documents attached to various comments. Some of these documents had not yet been considered during the preparation of the EA. We considered these documents upon receipt from the commenter during the preparation of this Final EA. These fall into two categories: (1) not cited because they do not add substantively to the information and analyses in the EA, and (2) added to and cited in the EA because they contained useful information.

5.28.1 Documents not cited because they do not add substantively to the information and analyses in the EA:

Elbroch and Quigley 2012, cougar kitten learning
Flagel *et al.* 2015, trophic cascades involving gray wolves, white-tailed deer, and vegetation
Iossa 2007, mammal trapping review
NY Times Editorial 2013, Agriculture's misnamed agency
Saether 2010, sustainable harvest Eurasian lynx
Bruskotter and Wilson 2013, determining where the wild things will be
Keefover 2012, wolves policy failure
Polisar *et al.* 2003, pumas, prey, and cattle ranching
Vickers 2015, mortality of pumas
Hooke 2006, M44 clinical signs and duration
Johnson *et al.* 2016, energy development is associated with reduced recruitment in large ungulate
Knudson 2012, suggestions in changing WS, newspaper story, Sacramento Bee on May 6, 2012
Treves 2014, tolerance for predatory wildlife
Kimball and Schiffman 2003, effects of cattle grazing.

Lewis *et al.* 2014, black bear population dynamics
Teichman *et al.* 2016, cougar-human conflict is positively related to hunting
Boulder Weekly news story, is dividing by five hiding the real culprit?
Harlow 1992, stress response of cougars
Lute *et al.* 2015, moral dimensions of human-wildlife conflict
Ripple 2016, saving the world's terrestrial megafauna
Sponarski *et al.* 2013, rural resident attitudes towards wolves
Zarco-Gonzales 2014, low cost deterrents for predation by felids
Allen *et al.* 2014,
Boulder weekly news story, what's in a name
Eklund 2017, interventions to reduce livestock predation
HSUS 2015, wildlife disservice
Lemieux 2006, traps and snares for capturing black bears
Treves 2003, perspectives on carnivore management
Weaver 1996, conservation of large carnivores in the Rocky Mountains
Boulder weekly news story, off target part 7
Hatton 2015, predator-prey power law
Vucetich *et al.* 2015, evaluating nature's intrinsic value
CPW summary of public comments to "Predator Management Plans"
Vucetich *et al.* 2007, what are 60 warblers worth?
CPW report on declining mule deer populations, 1999
HSUS 2017, state of the mountain lion
Unger 2013, status of black bear
Vucetich and Nelson, the infirm ethical foundations of conservation
Elbroch 2012, inter-trophic food provisioning pumas
Nelson *et al.* 2011, an inadequate construct, commentary.
Nelson *et al.* 2016, emotions and the ethics of consequence
Bonier *et al.* 2004,
Bryce 2017, movement energetics Dissertation
Cattet *et al.* 2004, Long-term capture effects ursids
Elbroch 2015, cougar social organization
Federal Aerial Accidents from WEG website
Husseman 2003, sympatric carnivores
Robinson 2014, compensatory mortality in mountain lions
Robinson *et al.* 2004.
Elbroch *et al.* 2004: contrasting bobcat values
Beston 2011, black bear
Chapron and Lopez-Bao 2016, coexistence with large carnivores
Conniff 2016, NY Times opinion, America's wildlife body count
Elbroch *et al.* 2017, carrion provided by pumas
Keefover 2012, deadliest dozen counties
USDA 2017, sheep and goat inventory
Wilmers *et al.* 2003, scavenging at wolf and hunter killed carcasses
Elbroch *et al.* 2017, adaptive social strategies in a solitary carnivore
Keefover 2009, WS war on wildlife
Sawyer *et al.* 2017, mule deer and energy development.
Wilmers *et al.* 2003, trophic facilitation by gray wolves Yellowstone
Slagle *et al.* 2017, attitudes toward predator control
Bergstrom 2017,
Chapron and Treves 2016, blood does not buy goodwill

Knopff 2010, cougars susceptible to snaring at wolf bait stations
Krofel 2015, hunted carnivores at outsized risk
Muth 2006, attitudes toward outlawing foothold traps
Ketcham 2008, America's secret war on wildlife
Knudson 2012, WS deadly force opens Pandora's Box, newspaper story, Sacramento Bee April 30, 2012.
O'Bryan *et al.* 2018, contribution of predators and scavengers to human well-being
Soule 2002, conservation goals for interactive species
Wallach 2015, what is an apex predator
Beck 1995, Black bear hunting
Knudson 2012, the killing agency, newspaper story published in the Sacramento Bee on April 28, 2012.
Stone *et al.* 2017, nonlethal strategies for wolf-sheep conflict
Van Valkenburgh 1987, killing behavior in large carnivores
Baker *et al.* 2008,
Bruskotter *et al.* 2011, rescuing wolves from politics
CPW wildlife research report on Piceance Basin mule deer project regarding oil and gas extraction, 2015.
Stoner *et al.* 2013, do cougars follow source-sink predictions
Wallach *et al*. 2017, cattle mortality on a predator-friendly station Australia
Vail Daily news article: CPW reports lower elk numbers in the Vail valley, as well as lower deer and bighorn numbers. CPW suggests habitat loss due to human development is the cause.
Letter from US Congress to Bill Clay 2011, asking for more detailed information on APHIS-WS expenditures nationwide.
Santiago-Avila 2018, killing wolves may protect one farm but harm neighbors

5.28.2 Documents added to and cited in the EA.

VS 2017, death loss cattle calves.
Grignolio 2011, hunting with hounds
Jackson 2014, effects of removal on coyote population
Mori 2017, effect of hunting with dogs on porcupines
Baruch-Mordo 2014, Aspen bears
USFWS 2017, wildlife recreation survey
Krumm 2009, mountain lions prey selectively on prion-infected mule deer
Bryce *et al.* 2017, energetic demands of pumas chased by hounds
Elbroch 2013, trailing hounds vs foot snares

5.29 Documents Outside the Scope of the EA.

We received numerous documents attached to various comments. We considered the content of these documents; some of them are outside the scope of the EA. These include:

Wielgus and Peebles 2014, effects of wolf mortality on livestock depredations.
Schmidt 2017, lethal wolf control Alaska
Ausband 2015, wolf harvest
Wielgus Bunnell 1995, sexual segregation in grizzly bears
Leclerc 2017, hunting promotes spatial reorganization in Scandinavian brown bear
Lute *et al.* 2014, differences in stakeholder concerns about hunting wolves.
Treves 2017, wolf mortality

Wiles *et al.* 2011, wolf conservation and management plan for Washington
Miller 2011, grizzly bear management in Alaska.
Fleischner 1994, ecological impacts of livestock grazing.
Gehring *et al.* 2010, livestock protection dogs for deterring wildlife from cattle
Belsky and Gelbard 2000, livestock grazing and weed invasions
Gehring *et al.* 2011, good fences make good neighbors
OIG 2005, audit report on APHIS' implementation of toxin regulations
Creel 2010, human offtake of wolves
McLellan 1999, grizzly mortality
Carter *et al.* 2011, moderating livestock grazing effects
Creel 2015, questionable policy for large carnivore hunting
Hogberg *et al.* 2013, public attitudes towards wolves in Wisconsin.
Shelley *et al.* 2011, attitudes to wolves and wolf policy
Santiago-Avila *et al.* 2018, lethal wolf control

CHAPTER 6. LIST OF PERSONS AND AGENCIES CONSULTED

Colorado Parks and Wildlife
Colorado Department of Agriculture
Colorado State Land Board
United States Department of Interior, Bureau of Land Management
United States Department of Agriculture, Forest Service
United States Department of Interior, United States Fish and Wildlife Service

CHAPTER 7.LIST OF PREPARERS

Name	Organization and Title
Todd Felix	USDA-APHIS-WS-Colorado Wildlife Biologist
Martin Lowney	USDA-APHIS-WS-Colorado State Director
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Appendix A. What Predator Damage Management Methods and Techniques Are Used in the Current Program?

1.1 Introduction

WS-Colorado works with federal, state, local agencies, private individuals, and associations to protect livestock, poultry, natural resources, property, companion animals and human safety from wildlife threats and damages. WS-Colorado conducts technical assistance (education and outreach) and operational wildlife damage management when requested.

Federal, state, tribal, and local regulations and APHIS-WS Directives govern APHIS-WS' use of damage management tools. The following methods and materials are recommended or used in technical assistance and operational damage management efforts of the WS-Colorado program. See Section 3.6.1.1 for a detailed discussion on humaneness of various IPDM methods.

1.2 What Non-Lethal IPDM Methods Are Available to WS-Colorado?

Non-lethal methods consist primarily of actions, tools, or devices used to disperse or capture a particular animal or a local population, modify habitat or animal behavior, create exclusion between predators and damage potential, and/or practicing husbandry to reduce the risk of or alleviate damage and conflicts. Most of the non-lethal methods available to WS-Colorado are also available to other entities within the state and could be used by those entities to damage. Depending on the method, the cooperator and/or the WS-Colorado employee may implement it. Livestock producers and property owners are encouraged by WS-Colorado to use non-lethal methods to prevent damage, especially when these methods are effective.

Each non-lethal method described below identifies its possible application as technical assistance and/or operational assistance.

1.2.1 Education: Technical Assistance

Education is an important element of IPDM activities and facilitates coexistence between people and wildlife. In addition to providing recommendations and information to entities experiencing damage, APHIS-WS provides lectures, courses, exhibits, presentations and demonstrations to government agencies, universities, and the public. Technical papers are presented at professional meetings and conferences to highlight recent developments in WDM technology, programs, laws and regulations, and agency policies. APHIS' Legislative and Public Affairs (LPA) program coordinates public outreach on WDM topics. APHIS-LPA and APHIS-WS work with agency partners, tribes, universities, extension programs, and others to develop educational materials about predator issues and methods to resolve problems.

1.2.2 Physical Exclusion: Technical Assistance

Physical exclusion methods can sometimes prevent predators from accessing valuable resources. Woven wire and other types of more permanent fencing, especially if it is installed with an underground skirt, can prevent many predator species that burrow, including coyotes, foxes, badgers, feral cats, and striped skunks. Areas such as airports, yards, pastures or hay meadows may be fenced. Hardware cloth or other metal barriers can sometimes be used to patch holes or gaps in existing structures, fences, or corrals. Entrance barricades are used to exclude bobcats, coyotes, foxes, opossums, raccoons, or skunks from dwellings, storage areas, gardens, or other areas.

Temporary fences, such as electric polytape fence or fladry fencing, are often used to protect livestock in temporary pastures, as night pens for sheep or goats, or for protection of small pastures. These systems may need to be maintained or moved frequently to avoid malfunctions or predator habituation and excessive grazing to the pasture.

Predator-proof fencing may be effective in confined situations or for protecting extremely high-value animals. These fences are designed with sufficient height and depth to prevent predators from jumping over or digging under. The initial cost of constructing a predator-proof fence often discourages their use, but may be economically practicable in small areas, such as calving grounds and bedding areas.

Electric fences have been used effectively to reduce predator damage to crops, apiaries and livestock. Bears have been dissuaded from landfills, trash dumpsters, cabins, and other properties using electric fencing. However, electric fencing can be expensive and requires constant maintenance to avoid short-circuiting.

1.2.3 Animal Husbandry: Technical Assistance

Animal husbandry practices may minimize livestock exposure to predators. Animal husbandry includes actions such as modifications in the level of care and attention given to livestock, shifts in the timing of breeding and births, selection of less vulnerable livestock species, and introduction of human and animal custodians to protect livestock. The duration of animal husbandry techniques may range from daily to seasonal. Generally, as the frequency and intensity of livestock handling increases, so does the degree of protection, since the risk of depredation is greatest when livestock are left unattended.

Shifts in breeding schedules can reduce the risk of depredation by altering the timing of births to coincide with the greatest availability of natural prey to predators or to avoid seasonal concentrations of migrating predators. Hiring extra herders, building secure holding pens, and adjusting the timing of births may be expensive, but effective. The timing of births is often related to weather or seasonal marketing of young livestock, and therefore shifts in breeding schedules may not always be feasible.

Herders and range riders are often used by producers to monitor sheep and cattle pastures for the presence of predators. Herders and range riders employee a variety of non-lethal methods, such as carcass removal, guard dogs, moving livestock to less vulnerable grazing or bedding area, and animal husbandry. Work often occurs during the day and night to effectively deter predators.

Pasture selection involves moving livestock to areas less susceptible to predation events, such as pastures near man-made structures. The risk of depredation diminishes as age and size increase and can be minimized by holding expectant females and newborn livestock in pens. Nightly gathering may not be possible where livestock are in many fenced pastures or where grazing conditions require livestock to scatter.

Behavior selection of livestock is the practice of choosing animals with nurturing or protective temperaments for breeding. Livestock that are more wary of predators or protective of their offspring help protect the herd from predation, especially when left in unattended pastures.

Guard animals, such as dogs, burros, donkeys, and llamas, can effectively reduce coyote predation losses. Success in using guard animals is highly dependent on proper breeding and bonding with livestock, amount and type of predation loss, size and topography of the pasture, effectiveness of training, compatibility with humans. The effectiveness of guarding animals may not be sufficient in areas where there is a high density of predators to be deterred, especially territorial pack species, and where livestock are scattered. The use of Old World guarding dog breeds, such as Great Pyrenees, Antatolian Shepard, Marema, Kangal, and Komondor, have been effective in protecting livestock from coyote predation in the United States. Guard donkeys have been used to deter dog and coyote predation with varied success. Guard llamas readily bond with sheep and are can reduce coyote predation. All technical assistance regarding guard dogs is conducted in compliance with WS Directive 2.440.

1.2.4 Habitat Management: Technical Assistance

Predator presence is often related to the type, quality, and quantity of suitable habitat. Habitat can be managed to reduce the attraction of certain predator species. The effectiveness of habitat management to reduce predator damage is dependent on the species involved, damage type, economic feasibility, and legal constraints on protected habitat types (e.g., wetlands). In most cases, the resource or property owner is responsible for implementing habitat modifications. WS-Colorado only provides advice on the type of modifications that have the best chance of achieving the desired effect. WS-Colorado advises landowners/managers that they are responsible for compliance with all applicable regulations related to habitat management, including the Endangered Species Act.

Architectural design can often help to avoid potential predator damage. For example, incorporating open areas into landscape designs that expose animals may significantly reduce potential problems. Additionally, selecting species of trees and shrubs that are not attractive to wildlife can reduce the likelihood of potential predator damage to parks, public spaces, or residential areas.

Managing the habitat, such as minimizing cover, planting lure crops, and tree removal, can sometimes reduce damage associated with predators that use vegetation and crops for foraging and hiding. Habitat management is a primary strategies at airports to reduce aircraft damage and protect human safety. Generally, many problems associated with predator's loafing, breeding, or feeding on airport properties can be minimized through management of vegetation and water from areas adjacent to aircraft runways.

Reducing food attractants or feeding of wildlife near homes, buildings, parks and pastures can reduce predator attraction. Sources include unprotected garbage, outdoor pet food, trash cans, and bird feeders. Removal or sealing of garbage, monitoring of small pets when outdoors, and elimination of outdoor pet food can reduce attracting unwanted predators. Additionally, proper and timely disposal of livestock carcasses also reduces predator attractants. Posting of signs prohibiting feeding of wildlife can discourage some feeding.

1.2.5 Modifying Animal Behaviors: Technical and/or Operational Assistance

Modifying animal behaviors involves techniques aimed at causing target animals to flee or remaining at a distance. Frightening and harassment devices are one of the oldest and most popular methods of reducing wildlife damage and depend on the animal's aversion to offensive stimuli. These methods usually use extreme and random noise or harassment and should be changed frequently as wildlife usually become habituated to scare devices. Motion-activated systems may also extend the effective period for a frightening devices. These techniques tend to be more effective when used in a strategy involving the use of multiple methods. However, their continued success may require reinforcement by limited lethal shooting to avoid habituation.

Electronic distress sounds and alarm calls are electronic devices that broadcast recorded or artificial wildlife distress sounds in the immediate area and are intended to cause a flight response from specific species. These sounds may be used alone or in conjunction with other scaring devices. Animals react differently to distress calls so their use depends on the species and problem. Calls may be played for short bursts, long periods, or even continually, depending on the severity of damage and relative effectiveness of different treatment or "playing" times. These calls can be used in urban areas effectively and without excessively disturbing humans. Distress and alarm calls are usually effective for short periods of time less than a month duration which provides time to implement other solutions.

Propane exploders/cannons are attached to a propane tank and produce loud explosions (similar to a firearm discharge) at controllable intervals. They are strategically utilized in areas of high wildlife. Because animals habituate to the sound, exploders must be moved frequently and used in conjunction with other scare devices. Propane cannons are generally inappropriate for urban/suburban areas due to the repeated loud explosions.

Pyrotechnics have a variety of forms, including firecrackers, shell crackers, noise bombs, whistle bombs, and racket bombs, and can be timed to explode at different intervals. Shell crackers are 12-gauge shotgun shells containing a firecracker that is projected up to 75 yards before exploding. The shells should be fired so they explode in front of, or underneath, the target animals. Noise bombs, whistle bombs, and racket bombs are similar to shell crackers, but are fired from 15-millimeter flare pistols. Noise bombs travel about 75 feet before exploding. Whistle bombs are non-explosive and produce a trail of smoke and a whistling sound. Racket bombs make a screaming noise, do not explode, and can travel up to 150 yards. Use of pyrotechnics may be precluded in some areas because of noise impacts. WS-Colorado employees receive safety training in transporting, using, and storing pyrotechnics, as required by WS Directives 2.615 and 2.625. When pyrotechnics are recommended during technical assistance, WS-Colorado provides pyrotechnics safety information and instructions to the user.

Electronic Guard (siren strobe-light devices), developed by APHIS-WS NWRC, is a battery-powered unit operated by a photocell that emits a flashing strobe light and siren call at intervals throughout the night. Efficacy of strobe-sirens is highly variable and typically lasts less than three weeks, but in certain situations, has been used successfully to reduce coyote and bear depredation on sheep. The device is a short-term tool used to deter predation until livestock can be moved to another pasture, brought to market, or other IPDM methods are implemented. This technique is most successful at bedding grounds where sheep or goats gather at night and may be used in rural or urban settings.

Visual scaring techniques such as lights, fladry, and effigies can be effective. These techniques are generally used for small, enclosed areas. Fladry, consisting of hanging flags evenly spaced along rope or fence wire, move in the wind and create a novel disturbance for predators. However, predators may become accustomed to fladry and the technique requires regular maintenance to replace the flags. Turbo fladry, similar to regular fladry, consists of colored flagging spaced evenly along a length of electrical fence. This technique reinforces the effectiveness of regular fladry with the shock deterrent of an electric fence. Fladry has been effective at protecting livestock in pastures as large as 40-acres for up to two months. It can be used as a night penning strategy.

Non-lethal projectiles, such as rubber bullets, can be used as an aversion technique, but require continued use to avoid wildlife becoming habituated. This method requires prolonged presence and is most efficient when the landowner assists with monitoring and implementation. WS-Colorado and CPW can provide technical assistance to property owners on how to safely implement this method. Non-lethal projectiles rarely result in death or injury to wildlife due to careful shot placement and avoiding close range use.

1.2.6 Live-Capture and Relocation: Operational Assistance

Live-capture and relocation, when not legally prohibited hy state and local law, can be used by WS-Colorado personnel, per WS Directive 2.501. WS-Colorado only relocates predators at CPWs direction and coordinates capture, transportation, and selection of relocation sites with CPW. Decisions to relocate wildlife are based on biological, ecological, economic, and social factors, such as availability of suitable habitat, likelihood of increased competition or predation stress on the relocated animal, likelihood of the animal returning, public attitudes, potential conflict or damage to resources near the relocation site, and potential disease transmission.

1.3 What IPDM Methods That May be Either Lethal or Non-Lethal Are Available to WS-Colorado?

WS-Colorado specialists can use a variety of devices to capture predators. Methods such as cage traps, cable devices, mechanical foot snares devices and trained pursuit dogs are used to non-lethally capture predators, but can be used lethally capture predators, depending on the circumstance. For instance, WS-Colorado can use a cage trap to capture an animal and then immobilize and relocate (non-lethal) or dispatch with a firearm (lethal), given the circumstances and applicable federal, state, and local laws and regulations.

All baits, scents, and attractants used to aid in capturing animals may consist of carcasses or parts of game animals, furbearers, and fish, provided that the animals are not taken specifically for this purpose and that such use and possession is consistent with Federal, State, and local laws or regulations per WS Directive 2.455. APHIS-WS Policy (WS Directive 2.450) states that the use of the BMP trapping guidelines developed by AFWA would be followed as practical. APHIS-WS policies and Colorado state statutes have resulted in WS-Colorado using only traps approved by the BMP process. Most of these methods can also be used by CPW, landowners, and their agents, as approved methods for IPDM or regulated fur trapping.

Cage/box traps are live-capture traps for capturing small mammals such as skunks, feral cats, opossum, and raccoons. Cage traps can also be used to catch bobcat and are being used to catch mountain lions. Cage traps come in a variety of sizes and are generally made of galvanized wire mesh, metal, plastic, or wood, and consist of a treadle inside the baited cage that triggers the door to close behind the animal being captured, preventing exit. Cage traps can range in size from small traps intended for the capture of smaller mammals to large corral/panel traps fitted with a routing or saloon-style repeating door, used to live-capture larger animals. Cage traps are species selective based on trap size which can physically exclude non-target animals. Traps are sometimes baited or set near signs of damage, known travel areas, or wildlife entrances to buildings or dens. Non-target animals are generally released with little or no injury. An adequate supply of food and water is placed in the trap to sustain captured animals for several days, but traps are typically checked more regularly. Cage traps are available to all entities to alleviate damage and can be purchased commercially.

Culvert traps are a type of large, baited, live-capture cage trap for large mammals. These traps have trigger systems attached to gravity doors, and are constructed of solid sheet metal on a wheeled platform or trailer. WS-Colorado most often uses this type of trap for black bears in urban/suburban settings, but culvert traps can also be used in rural areas and for other species. WS-Colorado implements a daily trap check for all culvert traps. Non-target animals are generally released with little or no injury and target bears are either euthanized or relocated as appropriate and when authorized by CPW.

Quick-Kill/Body Gripping Traps are used by WS-Colorado to capture various mammals, such as raccoons, skunks and badgers. The body-gripping trap is lightweight and consists of a pair of rectangular wire frames that close when triggered, killing the captured animal with a quick blow. Smaller-sized traps may also be set in the entrance of a wooden box or other structure with bait. Quick-kill traps set for predators are primarily used in rural areas, limiting non-target animal trap exposure. Restrictions on the size of the opening of the box containing the body gripping trap excludes dogs preventing their capture or injury. Quick-kill traps are lethal to both target and non-target animals. WS Directive 2.450 prohibits the use of body-gripping traps with a jaw spread exceeding 8 inches for land sets and Colorado statutes W-17 prohibits the use of any body-gripping traps having a jaw spread greater than 7 inches but less than 8.5 inches unless set in water, set greater than 5 feet above the ground or set in boxes with size or exclusionary devices to exclude dogs. Body gripping traps with a jaw spread in excess of 8.5 inches may only be set in water.

Foothold traps can be used for live-capture and release or hold for subsequent euthanasia. They are made of steel with springs that close the jaws of the trap around the foot of the target species. They are versatile for capturing small to large-sized predators. These traps usually permit the release of non-target animals unharmed. Foothold traps may have offset steel or padded jaws, which hold the animal while reducing the risk of injury. Foothold traps are have additional modifications with swivels and springs in the chain anchoring trap to reduce possibilities of injuries. The padded foothold trap can be unreliable in rain, snow, or freezing weather.

Traps are placed in the travel paths of target animals and some are baited or scented, using an olfactory attractant, such as the species' preferred food, urine, or musk/gland oils. Use of baits also facilitates prompt capture of target predators by decreasing the total time traps are used, thereby lowering risks to non-target animals. In some situations a draw station, a carcass or large piece of meat, is used to attract target animals. In this approach, one or more traps are placed in the vicinity of the draw station. APHIS-WS program policy prohibits placement of traps closer than 30 feet to the draw station to reduce the risk to non-target animals (APHIS-WS Directive 2.450).

Foothold traps set for coyotes, red foxes, bobcats, and similarly-sized predators are set with dirt or debris (e.g., leaf litter or rotting wood) sifted on top. The traps can be staked to the ground securely, attached to a solid structure (such as a tree trunk or heavy fence post), or used with a drag that becomes entangled in brush to prevent trapped animals from escaping. Anchoring systems should provide enough resistance that a larger animal that is unintentionally captured should be able to either pull free from the trap or be held to prevent escaping with the trap on its foot.

Effective trap placement also contributes to trap selectivity. To minimize risk of capturing non-target animals, the user must be experienced and consider the target species' behavior, habitat, environmental conditions, and habits of non-target animals. The pan tension, type of set, and attractant used greatly influences both capture efficiency and risks of catching non-target animals. The level of trap success is often determined by the training, skill, and experience of the user to adapt the trap's use for specific conditions and species. When determining how often to check traps, the user must balance the need for avoiding unnecessary disturbance of the trap area and humaneness of trapping to the captured animals. WS-Colorado follows state law and regulations regarding the setting and checking of traps, cable devices and foot snares as follows per APHIS-WS Directive 2.450 and 2.210.

Enclosed foothold traps are designed for particular species, such as raccoons or opossums, which use their foot to reach into small, enclosed spaces to gain access to bait. These traps are baited or scented, using an olfactory attractant, such as the species' preferred food, to attract the animal. When an animal reaches into the trap and pulls on the baited lever, a spring quickly closes the trap around the animal's foot. The traps are often made of rounded plastic or metal, which holds the animal while reducing the risk of harm. The enclosed foothold trap can be set under a wide variety of conditions but can be unreliable in rain, snow, or freezing weather. The traps are either staked to the ground securely or attached to a solid structure (such as a tree trunk or heavy fence post).

The enclosed foothold trap minimizes unintentional capture due to the species-selective attractants, enclosed space that physically prevents larger species from being captured, and the behavioral differences between species by requiring the animal to put their foot into the trap to access the bait. These traps usually permit the release of unintentionally captured animals unharmed.

WS-Colorado follows the laws and regulations regarding the setting and checking of traps, cable devices and foot snares as follows per APHIS-WS Directive 2.450 and 2.210.

Cable devices (foot snares and neck/body snares) can be used for live-capture and release, for holding for subsequent euthanasia, or for a direct kill, depending on how and where they are set. They are traps made of strong, lightweight cable, with a locking device, and are used to catch small- and medium-sized predators by the neck, body, or foot. Cable devices can be used effectively on animal travel corridors, such as under fences or trails through vegetation.

When an animal steps into the cable loop placed horizontally on the ground, a spring is triggered, and the cable tightens around the foot to hold the animal. If the cable device is placed vertically, the animal walks into through the loop and the neck or body is captured or entangled. On standard cable devices, locks are typically used to prevent the loop from opening again once the loop has closed around an animal. Loop stops can also be incorporated to prevent the loop from closing beyond a minimum loop circumference, which can effectively exclude non-target animals or allow for live-captures of target animals.

Cable devices are also equipped with a swivel to minimize injuries to the captured animal and reduce twisting and breakage of the cable. Breakaway devices can also be incorporated into cable devices, allowing the loop to break open and release the animal when a specific amount of force is applied. These devices can improve the selectivity of cable devices to reduce non-target species capture, however only when the non-target species is capable of exerting a greater force to break the loop than the target species.

The Collarum™ is a non-lethal, spring-powered, modified neck snare device that is primarily used to capture coyotes and foxes. It is activated when an animal bites and pulls a cap with a lure attractive to coyotes, whereby the snare is projected from the ground up and over the head of the coyote or fox. As with other types of snares, the use of the Collarum™ device to capture coyotes is greatly dependent upon finding a location where coyotes frequently travel where the device can be set. A stop on the device limits loop closure. The trigger is designed specifically for canines, which use a distinct pulling motion to set off the device.

In general, cable devices are available to all entities to alleviate damage within state law. Cable devices offer several advantages over foothold traps by being lighter to transport or carry and not being as affected by inclement weather.

Trap monitors are devices that send a radio signal to a receiver if a set trap is disturbed, alerting field personnel that an animal may be captured. Trap monitors can be attached directly to the trap or attached to a wire and placed away from the trap. When the monitor is hung above the ground, it can be transmit a signal for several miles, depending on the terrain. There are many benefits to using trap monitors, such as saving considerable time when checking traps, decreasing fuel usage, prioritizing trap checks, and decreasing the need for human presence in the area. By using trap monitors to prioritize trap checks, the amount of time a captured animal is restrained is decreased, minimizing pain and stress and allowing non-target animals to be released in a timely manner.

APHIS-WS continues to review trap monitoring systems that are commercially available, but modern trap monitors are not sufficiently reliable due to variable terrain, poor signal reception, and rudimentary monitor technologies. Newer technologies, such as cell phone text messages, rely on cell reception to transmit signals which is not always available in rural areas. WS-Colorado continues to look for opportunities to test current and developing systems.

Catch poles consist of a long pole with a cable noose at one end. They can be used for live-capture and release, relocation, or subsequent euthanasia. The noose end is typically encased in plastic tubing to protect the neck of the animal. Catch poles can be used to safely catch and restrain animals such as bear cubs, feral cats, feral dogs, and raccoons.

Hand nets are used to catch small mammals in confined areas, such as buildings. They can be used for live-capture and release, relocation, or subsequent euthanasia. These nets resemble fishing dip nets, but are larger and have long handles.

Net guns and launchers are devices that project a net over a target animal using a specialized gun and are normally used for animals that do not avoid people. They can be used for live-capture and release, or for holding for subsequent euthanasia. They require mortar projectiles or compressed air to propel a net up and over animals that have been baited to a particular site. Net guns are manually discharged, while net launchers are discharged by remote from a nearby observation site. Net guns can be used in rural and urban situations and discharged from the ground, helicopter, or vehicle. Net guns are an animal-specific, live-capture technique, with target animals typically released unharmed.

Dart guns are non-lethal capture devices (specially-designed rifles) that fire darts filled with tranquilizer. Once tranquilized, the animal may be handled safely for research or relocation purposes, or subsequently euthanized. Use of dart guns are species-selective, as field personnel positively identify the species before tranquilizing the animal. Dart guns are generally limited in range to less than 120 feet. If other factors preclude setting of equipment or the use of firearms, such as proximity to urban or residential areas, dart guns may be the only option available. Chemical capture methods require specialized training and skill, and are limited to WS-Colorado and other certified entities.

Trained pursuit dogs are used by some hunters, agents of CPW and WS-Colorado for coyote, cougar, and bear damage management activities on both private and public lands, typically in rural settings. Pursuit dogs are trained to follow the scent of the target species and can be used to find coyote dens, decoy coyotes, and pursue problem bears and cougars. Once the target animal is located by the pursuit dogs, field personnel use dart guns or firearms to euthanize the animal or immobilize for release. Pursuit dogs are always accompanied by field personnel and are redirected if found to be following the tracks or scent of non-target animals. Trained dogs are especially effective at indicating where predators have traveled, urinated, or defecated, which may be useful for setting cable restraints or traps and increase the certainty of capturing the target species.

Per WS Directive 2.445, the dogs are not allowed to have any physical contact with the animal either before or after capture. Individual dogs that cannot be restrained from physical contact with wildlife or continue to follow non-target scents are discontinued from use. All dogs shall have a safe and insulated transport box, food, water, medical care, and be licensed and vaccinated.

1.4 What Lethal IPDM Methods Are Available to WS-Colorado?

1.4.1 Aerial Shooting: Technical Assistance or Operational Assistance

Aircraft, both fixed-wing and rotary-wing (helicopters) are used by WS-Colorado only for removing coyotes or feral swine. The most frequent aircraft used for aerial shooting and harassment is the fixed-wing aircraft Piper PA-18 Super Cub and rotary-wing Hughes MD500. WS-Colorado conducts aerial activities on areas only under signed agreement or federal Annual Work Plans, and concentrates efforts to specific areas during certain times of the year. Additionally, WS-Colorado may conduct the work operationally at the request of cooperators.

Aerial shooting consists of visually sighting target animals in the problem area and shooting them with a firearm from an aircraft. Aerial shooting is species-specific and can be used for immediate damage relief, providing that weather, topography and ground cover conditions are favorable. Aerial shooting can be effective in removing offending animals that have become trap-shy or are not susceptible to calling and shooting or other methods. This method may also be used proactively to reduce local coyote predations in lambing and calving areas with a history of predation.

Fixed-wing aircraft are useful for aerial shooting over flat and gently rolling terrain. Because of their maneuverability, helicopters have greater utility and are safer over timbered areas or broken land where animals are more difficult to spot. Aerial shooting typically occurs in remote areas with low densities of tree or vegetation cover, where the aerial visibility of target animals is greatest. WS-Colorado spends relatively little time flying and shooting over any one area.

The APHIS-WS program aircraft-use policy (WS Directive 2.620) and APHIS-WS Aviation Rules (WS 2015) help ensure that aerial shooting is conducted in a safe and environmentally sound manner, in accordance with federal and state laws. State Directors and Program Managers are responsible for the supervision, management, and compliance for all aviation activities within the state, and all aircraft used by WS-Colorado activities through contract or agreement shall have been approved by the office of the APHIS-WS National Aviation Coordinator (NAC). WS Directive 2.615 guides all APHIS-WS shooting activities. All efforts are conducted in strict compliance with the APHIS-WS Aviation and Safety Manual, the Federal Aviation Regulations, the Fisb and Wildlife Act of 1956 (Airborne Hunting), any applicable State and local laws and regulations, individual WS-Colorado and APHIS-WS program Aviation Safety Plan, Aviation Communication Plans, and Aviation Emergency Response Plans.

The APHIS-WS Aviation Training and Operations Center (ATOC) located in Cedar City, Utah, mission is to improve aerial operations safety and provide training and guidance for APHIS-WS aviation personnel and aerial activities. The policy and primary focus of APHIS-WS and contract aviation personnel is ensuring the well-being througb safety and accident prevention efforts. Pilots and aircraft must be certified under established APHIS-WS program procedures. Only properly trained APHIS-WS program employees are approved as crewmembers. Ground crews are often used with aerial operations for safety and for providing assistance with locating and recovering target animals.

1.4.2 Ground Shooting: Technical or Operational Assistance

WS-Colorado personnel may either provide advice regarding ground shooting for predators as part of tecbnical assistance or provide the service themselves. Ground shooting with firearms is highly-selective for target species. Shooting can be selective for offending individuals and has the advantage that it can be directed at specific damage situations. The majority of shooting occurs in rural areas on both private and public lands, as well as airports for health and human safety. Shooting is sometimes used as one of the first lethal damage management options because it offers the potential of resolving a problem quickly and selectively. Shooting is limited to locations where it is legal and safe to discharge a weapon.

Calling and shooting is a technique which uses electronic devices that broadcast recorded or artificial wildlife sounds in the immediate area and are intended to draw specific species to an area where they can be lethally removed with a firearm. Animals react differently to these calls so their use depends on the species and problem. Calls are often played for short bursts and cause minimal disturbance.

A handgun, shotgun, air gun, or rifle may be utilized. In addition, a spotlights, night vision, thermal imagery for night shooting, decoy dogs, predator calling, stalking, and/or baiting may be used to increase ground shooting efficiency and selectiveness. Spotlights are often covered with a red lens which nocturnal animals may not be able to see, making it easier to locate them undisturbed. Night shooting may be conducted in sensitive areas that have high public use or other activity during the day, which would make daytime shooting unsafe. The use of night vision and Forward Looking Infrared (FLIR) devices can also be used to detect and shoot predators at night. Coyotes and red foxes that may be trap-wise and therefore difficult to trap, are often responsive to simulated predator calling.

To ensure safe use and awareness, APHIS-WS employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within three months of their appointment and a refresher course annually thereafter (WS Directive 2.615). The use and possession of firearms must be in accordance with federal, state, and local laws and regulations (also WS Directive 2.210). APHIS-WS personnel must adhere to all safety standards of firearm operation as described in the APHIS-WS Firearms Safety Training Manual. Such personnel are subject to drug testing when considered for hire, randomly, when under reasonable suspicion, and after accidents have occurred. All employees who are use firearms are subject to the Lautenburg Domestic Confiscation Law, which prohibits firearm possession by anyone convicted of a misdemeanor crime or domestic violence. WS-Colorado complies with state laws, statutes, and CPW authorized methods for ground shooting.

While on duty, APHIS-WS employees are authorized to store, transport, carry, and use only the firearms necessary to perform official APHIS-WS duties. The maximum type of security available must be used to secure firearms when not directly in use and to ensure that unauthorized access is prevented. No firearms shall be left unattended unless securely stored. Authorization is required for leaving firearms stored in vehicles overnight. Ammunition, pyrotechnic pistols, net guns, dart guns, air rifles, and arrow guns will be stored securely unloaded as determined by the State Director.

CPW, commercial operators, and landowners/resource owners can also use ground shooting for IPDM, in compliance with state laws and regulations.

1.4.3 Carcass Disposal: Technical Assistance or Operational Assistance

Carcass disposal methods are dependent on the species. WS-Colorado disposes of carcasses according to WS Directives 2.515 and 2.510. Predator carcasses are disposed of in approved carcass disposal sites on public or private lands or on-site where captured. WS-Colorado does not bury predator carcasses.

1.5 What Lethal and Non-lethal Chemical Methods are Available to WS-Colorado?

1.5.1 Chemical Repellents (Non-lethal): Technical and Operational Assistance

Chemical repellents are usually naturally-occurring substances or formulated chemicals that are distasteful or to elicit temporary pain or discomfort for target animals when they are smelled, tasted, or contacted. Effective and practical chemical repellents should be non-toxic to target predators, other wildlife, plants, and humans; resistant to weathering; easily applied; and highly effective.

The reaction of different animals to a particular chemical varies, and for many species there may be variations in repellency between different habitat types. Effectiveness depends on the resource to be protected, time and length of application, and sensitivity of the species causing damage. Repellents are not available for many species that may cause damage problems. Chemicals are not used by WS-Colorado on public or private lands without authorization from the land management agency or property owner or manager.

1.5.2 Chemical Fumigants (Lethal): Operational Assistance

Denning is the practice of locating coyote, fox, and skunk dens and killing the young and/or adults by using a registered gas fumigant cartridge. This method used to manage present depredation of livestock by coyotes, fox, and skunks or anticipated depredation from coyotes. When the adults are killed and the den site is known, denning is used to euthanize the pups and prevent their starvation. Denning is highly selective for the target species responsible for damage. Den hunting for coyotes and red foxes is often combined with other damage management activities such as aerial shooting and ground shooting.

Gas cartridges are normally applied in rural settings on both private and public lands. When dens are selected for fumigation, the fuse of the gas cartridge is ignited and hand-placed at least three to four feet inside in the active den. Soil is then placed in the den entrance to form a seal to prevent tbe carbon monoxide from escaping and oxygen entering. Sodium nitrate is the principal active chemical in gas cartridges and is a naturally-occurring substance. When ignited, the cartridge burns in the den, depleting the oxygen and producing large amounts of carbon monoxide, a colorless, odorless, tasteless, poisonous gas.

Use of gas cartridges may pose a risk to non-target animals that may also be found in burrows of target predators. Given the omnivorous nature of target predator diets, non-target rodents, reptiles or amphibians are highly unlikely to occur in a coyote or fox den. WS-Colorado conducts pretreatment site surveys to identify signs of use by non-target species (such as tracks or droppings).

All animals removed by denning are humanely euthanized per WS Directives 2.425 "Denning" and 2.505 "Lethal Control of Animals". The gas cartridges used for denning (EPA Reg. No. 56228-21, EPA Reg. No. 56228-2) are registered by WS-Colorado with CDA. All pesticides used by WS-Colorado are registered under the FIFRA and administered by EPA and ODA. All WS-Colorado personnel who apply restricted-use pesticides are state-certified pesticide applicators and have specific training by WS-Colorado for pesticide application per WS Directive 2.465. Gas cartridges may be used by private individuals in Colorado only to fumigate rodents.

1.6 What Tranquilizer and Immobilization Methods are Available to WS-Colorado?

Tranquilizer and immobilization chemicals may be used by WS-Colorado to aid in the humane handling of predators to avoid injury to the handler and the predator. Immobilization agents can eliminate pain and reduce stress of animals while being handled. Immobilizing agents are delivered to the target animal with a dart gun or syringe pole, depending on the circumstances and the species being immobilized. WS-Colorado field personnel may use immobilization drugs to safely release unintentionally captured animals. Immobilizing drugs may also be used to safely release animals after collecting biological samples for disease surveillance or research studies.

When administering tranquilizer or immobilization chemicals to any animal, field personnel must consider the animal's physical condition, size, age, and health. WS Directive 2.430 provide detailed training and certification requirements for APHIS-WS personnel administering immobilization drugs. The following immobilization chemicals are under the jurisdiction of the United States Food and Drug Administration (FDA) and/or DEA.

Ketamine (Ketamine HCl; Ketaset™) is a rapid acting, non-narcotic, non-barbiturate injectable anesthetic agent that immobilizes the animal and prevents the ability to feel pain (analgesia). The drug produces a state of dissociative unconsciousness, which does not affect the reflexes needed to sustain life, such as breathing, coughing, and swallowing. Ketamine is possibly the most versatile drug for chemical capture and has a wide safety margin (Fowler and Miller 1999). When used alone, this drug may produce muscle tension, resulting in shaking, staring, increased body heat, and, on occasion, seizures. Ketamine is often combined with other drugs, such as Xylazine, maximizing the reduction of stress and pain and increasing human and animal safety during handling. Following administration of recommended doses, animals become immobilized in about 5 minutes, with anesthesia lasting from 30 to 45 minutes. Depending on dosage, recovery may be as quick as four to five hours or may take as long as 24 hours. Recovery is generally smooth and uneventful.

Xylazine is a sedative (analgesic) that calms nervousness, irritability, and excitement, usually by depressing the central nervous system. Xylazine is commonly used with Ketamine HCl to produce a relaxed anesthesia. This combination can reduce heat production from muscle tension, but can lead to lower body temperatures when working in cold conditions. Xylazine can also be used alone to facilitate physical restraint. Because Xylazine is not an anesthetic, sedated animals are usually responsive to stimuli. Therefore, personnel must minimize sight, sound, and touch to minimize the animal stress. Recommended dosages are administered through intramuscular injection, allowing tbe animal to become immobilized in about 5 minutes and lasting from 30 to 45 minutes. Yohimbine is a useful drug for reversing the effects of Xylazine.

Capture-All 5™ is a combination of Ketaset™ and Xylazine, and is regulated by the FDA as an investigational new animal drug. The drug is available through licensed veterinarians to individuals sufficiently trained in the use of immobilization agents. Capture-All 5™ is administered by intramuscular injection; it requires no mixing, and has a relatively long shelf life without refrigeration, all of whicb make it ideal for the sedation of various species.

Telazol™ is a combination of equal parts of tiletamine hydrochloride and zolazepam hydrochloride, and is a powerful anesthetic for larger animals, such as bears, coyotes, and cougars (Fowler and Miller 1999). Telazol™ produces dissociative unconsciousness, which does not affect the reflexes needed to sustain life, such as breathing, coughing, and swallowing. Following a deep intramuscular injection of Telazol™, onset of anesthetic effect usually occurs within 5 to 12 minutes. Muscle relaxation is optimum for about the first 20 to 25 minutes after administration, and then diminishes. Recovery varies with the age and physical condition of the animal and the dose of Telazol™ administered, but usually requires several hours. Although the combination of Ketamine HCl and Xylazine are effective, WS-Colorado prefers to use Telazol™ for most of tbe species that are immobilized.

1.7 What Euthanasia Methods are Available to WS-Colorado?

During IPDM activities, most captured animals are euthanized since predators rarely are permitted to be immobilized and relocated. Euthanasia methods can include physical and chemical methods. Euthanasia techniques should result in rapid unconsciousness, quickly followed by death, in order to minimize stress, anxiety, and pain to the animal. In urban and suburban locations, chemical techniques can be more appropriate for euthanizing wildlife than shooting.

APHIS-WS personnel will exhibit a high level of respect and professionalism when taking an animal's life, regardless of method (WS Directive 2.505). Only properly trained APHIS-WS personnel are certified to possess and use approved immobilization and euthanizing drugs. All acquisition, storage, and use of such drugs will be in compliance with applicable program, Federal, state, and local laws and regulations.

The following chemical and gas methods are limited to WS-Colorado operational assistance. Physical euthanasia methods can be used by landowners in accordance with applicable laws and regulations, and can be recommended during technical assistance.

1.7.1 *Chemical and Gas Euthanasia Methods (Lethal): Operational Assistance*

Depending on the species, the following euthanizing drugs and gases (AVMA 2013) can be used by WS-Colorado and are under the jurisdiction of FDA and/or DEA. WS-Colorado personnel are trained and certified to use, record, and store euthanizing drugs in accordance with DEA and state regulations.

Sodium pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. Barbiturates are a recommended euthanasia drug for free-ranging wildlife (AVMA 2013). Sodium pentobarbital would only be administered after target animals were live-captured and properly immobilized to allow for direct injection. All animals euthanized using sodium pentobarbital and its dilutions (such as Beuthanasia-D™ and Fatal-Plus™) are disposed of at approved carcass disposal sites.

> **Beuthanasia®-D and Euthasol®** contain two active ingredients (sodium phenytoin and sodium pentobarbital) which are chemically compatible but pharmacologically different. When administered intravenously, sodium pentobarbital produces rapid anesthetic action followed by a smooth and rapid onset of unconsciousness. When administered intravenously, sodium phenytoin produces toxic signs of cardiovascular collapse and/or central nervous system depression, and hypotension can occur when the drug is administered rapidly. Sodium phenytoin exerts its effects during the deep anesthesia stage caused by sodium pentobarbital. Sodium phenytoin hastens the stoppage of electrical activity in the heart, causing a cerebral death in conjunction with and prior to respiratory arrest and circulatory collapse. This sequence of events leads to a humane, painless and rapid euthanasia (Schering-Plough Animal Health 1999). Beuthanasia®-D and Euthasol® are regulated by the DEA and the FDA for rapid and painless euthanasia of dogs, but legally may be used on other animals if the animal is not intended for human consumption (WS Directive 2.430).
>
> **Fatal-Plus®** combines sodium pentobarbital with other substances to hasten cardiac arrest. Intravenous use is the preferred route of injection, however intra-cardiac injection is acceptable as part of the two-step procedure used by WS-Colorado. Animals are first anesthetized and sedated using a combination of Ketamine/Xylazine and, once completely unresponsive to stimuli and thoroughly sedated, Fatal-Plus® is administered.

Potassium chloride, a common laboratory salt, is intravenously injected as a euthanizing agent after an animal has been anesthetized (WS Directive 2.430).

Carbon dioxide (CO_2) gas is a colorless, odorless, non-combustible gas approved by the AVMA as a euthanasia method. CO_2 is a common euthanasia agent because of its ease of use, safety, and ability to euthanize many animals in a short time span. The advantages for using CO_2 are: 1) the rapid depressant, analgesic, and anesthetic effects of CO_2 are well established, 2) CO_2 is readily available and can be purchased in compressed gas cylinders, 3) CO_2 is inexpensive, non-flammable, non-explosive, and poses minimal hazard to personnel when used with properly designed equipment, and 4) CO_2 does not result in accumulation of tissue residues. Inhalation of CO_2 at a concentration of 7.5% increases the pain threshold and higher concentrations of CO_2 have a rapid anesthetic effect.

WS-Colorado uses CO_2 to euthanize wildlife which have been captured in cage traps, by hand, or by chemical immobilization. Live animals are placed in a container and CO_2 gas from a cylinder is released into the container. The animals quickly expire after inhaling the gas. This method of euthanasia is appropriate for small predators, such as skunks and raccoons, and could be effective in urban/suburban areas where use of a firearm is not appropriate.

Carbon monoxide (CO) is one of the gaseous byproducts from M-44 devices. Carbon monoxide is poisonous to all animals that use hemoglobin to transport oxygen from the lungs to the cells of the body. Carbon monoxide prevents the binding of oxygen to blood cells, causing a decrease in oxygen to cells throughout the body, resulting in asphyxiation. CO induces the loss of consciousness without pain and witb minimal discomfort. Death occurs rapidly at low concentrations.

1.7.2 Physical Euthanasia Methods: Technical or Operational Assistance

Cervical Dislocation is sometimes used to euthanize small predators which are captured in live traps. The animal is stretched and the neck is hyper-extended and dorsally twisted to separate the first cervical vertebrae from the skull. When done properly, the AVMA approves this technique as humane method of euthanasia. Cervical dislocation is a technique that may induce rapid unconsciousness and does not chemically contaminate tissue (AVMA 2013).

Shooting is a humane field method of euthanasia when conducted by experienced personnel. A gunshot is placed between the ears to damage brain tissue, resulting in instantaneous death. Shooting may be the quickest and only method available under most field conditions and should be performed discretely by properly trained personnel (AVMA 2013).

1.8 What Chemical Pesticide Methods are Available to WS-Colorado?

Pesticides have been developed to reduce wildlife damage and are used because of their efficiency. The use of many pesticides may be hazardous unless used with care by knowledgeable, trained, and state-certified field personnel. Tbe proper placement, size, type of bait, and time of year are keys to selectivity and successful use. Most cbemicals are aimed at a specific target species.

Sodium cyanide is the only registered pesticide available for IPDM in Colorado (EPA Reg. No. 56228-15). This pesticide can only be used by certified WS-Colorado personnel, and therefore is only available during operational assistance. The use of M-44s for IPDM activities occur in rural settings on private properties only. Use of M-44s on private or sovereign tribal lands in Colorado must be agreed upon by the landowner or tribal land management agency.

Sodium cyanide is the active ingredient in the M-44, a spring-activated ejector device developed specifically for lethal removal of coyotes, and, to a substantially lesser degree, other canine predators. The M-44 device consists of a capsule holder wrapped with fur, cloth, or wool; a capsule containing 0.8 gram of powdered sodium cyanide; an ejector mechanism; and a 5- to 7-inch hollow stake. The hollow stake is driven into the ground, the ejector unit is set and placed in the stake, and the capsule holder containing the cyanide capsule is screwed onto the ejector unit. A rotten meat bait is spread on the capsule holder.

An animal attracted by the bait will try to pick up or pull the baited capsule holder. When the M-44 is pulled, a spring-activated plunger propels sodium cyanide directly into the animal's mouth. Generally, death from respiratory arrest is immediate. The M-44 is generally selective for canids because of the attractants used and their feeding behavior. When properly used, the M-44 presents little risk to humans and the environment and provides an additional tool to reduce predator damage.

Sodium cyanide is highly toxic to all species, including humans. WS-Colorado personnel carry an antidote kit on their person, which consists of six amyl nitrite pearls, while setting or checking M-44s, which counteracts the effect of an accidental exposure. APHIS-WS personnel that use tbe M-44 must he certified by the CDA since it is a restricted-use pesticide. WS-Colorado personnel always follow the EPA's label of 26 use restrictions and WS Directives 2.401 and 2.415. Per the EPA registration label, M-44 devices may only be used for control of coyotes, red foxes, gray foxes, and wild dogs that are vectors of communicable diseases or suspected of preying on livestock, poultry, and/or federally-listed T&E species.

In response to petition from an environmental advocacy organization, the EPA completed a review of complaints concerning risks to non-target species (including T&E species), environmental contamination, and human health and safety risks regarding use of sodium cyanide (EPA 2009). Based on the review and updated use restrictions, the EPA determined that use of M-44s are in accordance with label requirements. EPA determined that the revised APHIS-WS pesticide accounting and storage practices do not pose unreasonable risks to the environment.

1.9 Literature Cited

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APPENDIX B: WS-Colorado Aerial PDM on BLM Lands FY12-16.

WS-Colorado aerial predator management time and days flown on Bureau of Land Management (BLM) lands in Colorado during federal fiscal year (FY) 2012-2016.

BLM Resource Area (RA)	Allotment Name	Acres	Aerial Predator Management Hours						Days Flown					
			FY12	FY13	FY14	FY15	FY16	**Avg.**	FY12	FY13	FY14	FY15	FY16	**Avg.**
Glenwood	Bocco Mtn.	4,040	0.9	-	-	-	-	**0.2**	1	-	-	-	-	**0.2**
	State Bridge	5,699	1.9	-	-	-	-	**0.4**	2	-	-	-	-	**0.4**
Subtotal Glenwood		**9,739**	2.8	-	-	-	-	**0.6**	3	-	-	-	-	**0.6**
Grand Junction	Badger Wash	60,000	-	-	3.8	-	-	**0.8**	-	-	3	-	-	**0.6**
	East Salt Ck.	30,000	-	-	3.0	-	-	**0.6**	-	-	3	-	-	**0.6**
	Prairie Canyon	58,000	-	-	1.9	-	-	**0.4**	-	-	3	-	-	**0.6**
Subtotal Grand Junction		**148,000**	**-**	**-**	**8.7**	**-**	**-**	**1.7**	**-**	**-**	**9**			**1.8**
Gunnison	Sapinero Mesa	**5,160**	**-**	**1.5**	**-**	**2.6**	**2.0**	**1.2**	**-**	**1**	**-**	**1**	**1**	**0.6**
Little Snake	Buck Mtn.	923	-	0.5	-	-	-	**0.1**	-	1	-	-	-	**0.2**
	Cedar Spgs.	19,319	-	-	-	-	1.9	**0.4**	-	-	-	-	3	**0.6**
	Crooked Wash	7,889	-	-	-	-	3.8	**0.8**	-	-	-	-	5	**1.0**
	Duffy Mtn.	8,545	1.0	1.0	2.4	1.5	2.2	**1.6**	2	1	4	2	4	**2.6**
	Fortification	4,413	3.8	11.5	4.5	9.1	9.0	**7.6**	6	18	9	16	19	**13.6**
	Greasewood	19,858	3.2	0.6	0.5	9.8	6.8	**4.2**	3	1	1	10	11	**5.2**
	Hdq Moffat	3,077	-	-	2.0	-	2.3	**0.9**	-	-	1	-	4	**1.0**
	Lay Peak	855	-	-	-	-	0.6	**0.1**	-	-	-	-	1	**0.2**
	Mud Spg. Gulch	978	1.3	-	-	-	-	**0.3**	1	-	-	-	-	**0.2**
	Nipple Peak	4,449	2.3	2.0	0.2	4.4	10.5	**3.9**	3	3	1	6	8	**4.2**
	Nipple Rim	39,677	1.4	3.3	3.0	4.0	-	**2.3**	1	2	3	3	-	**1.8**
	Pole Gulch	16,317	2.0	2.9	0.8	5.6	2.0	**2.7**	1	4	2	8	2	**3.4**
	Powder Wash	29,967	13.6	5.8	1.0	-	-	**4.1**	10	5	1	-	-	**3.2**
	Sand Creek	8,728	-	-	-	-	0.5	**0.1**	-	-	-	-	1	**0.2**
	Red Wash	15,758	1.0	-	0.7	1.0	1.1	**0.8**	1	-	1	1	2	**1.0**
	Sand Wash	64,809	21.8	3.5	1.0	7.5	7.5	**8.3**	14	4	1	4	7	**6.0**
	Sheepherder Spg	84,491	6.6	7.1	-	4.5	5.6	**4.8**	6	3	-	4	5	**3.6**
	Shell Creek	7,880	1.5	-	0.6	-	-	**0.4**	3	-	1	-	-	**0.8**
	Snake River	51,710	5.7	7.8	10.3	4.6	9.0	**7.5**	8	8	11	7	10	**8.8**
	State Line	6,373	-	-	0.6	-	-	**0.1**	-	-	1	-	-	**0.2**
	West Spring Ck.	7,308	-	-	-	-	1.0	**0.2**	-	-	-	-	2	**0.4**
Subtotal Little Snake		**403,324**	**65.2**	**46.0**	**27.6**	**52.0**	**63.8**	**50.9**	**59**	**50**	**37**	**61**	**84**	**58.2**
San Juan	Yellow Jacket	**5,727**	**-**	**0.5**	**-**	**-**	**-**	**0.1**	**-**	**1**	**-**	**-**	**-**	**0.2**
Uncompahgre Basin	Alkali Flats	35,439	1.1	-	-	-	-	**0.2**	2	-	-	-	-	**0.4**
	Canal	10,482	0.5	0.9	1.4	2.5	1.7	**1.4**	1	1	3	2	2	**1.8**
	Cushman	6,386	-	-	-	-	0.6	**0.1**	-	-	-	-	2	**0.4**
	Deer Basin	11,360	0.7	-	-	-	-	**0.1**	1	-	-	-	-	**0.2**
	Lower Escalante	2,240	1.1	0.8	1.9	0.5	0.5	**1.0**	2	1	3	1	1	**1.6**
	Pipeline	10,354	-	-	-	-	0.2	**0.0**	-	-	-	-	1	**0.2**
	Sandy Wash	7,224	0.9	0.3	1.3	0.5	2.4	**1.1**	2	1	3	1	2	**1.8**
	Shavano	2,016	0.2	-	-	-	-	**0.0**	1	-	-	-	-	**0.2**
	Smith Mtn.	3,477	0.5	1.7	2.2	1.5	2.0	**1.6**	2	6	7	4	7	**5.2**
	South of Town	3,391	2.5	2.8	2.8	2.4	3.3	**2.8**	6	8	7	5	8	**6.8**
	Sulphur Gulch	468	1.8	1.5	2.2	1.5	2.2	**1.8**	6	6	7	4	8	**6.2**
	U. Peach Valley	3,727	3.1	3.8	3.2	3.1	3.4	**3.3**	7	9	7	5	8	**7.2**
Subtotal Uncompahgre Basin		**96,564**	**12.4**	**11.8**	**15.0**	**12.0**	**16.3**	**13.5**	**30**	**32**	**37**	**22**	**39**	**32.0**
White River	Banta Flats	17,871	1.6	9.0	3.8	2.1	1.5	**3.6**	1	5	3	1	1	**2.2**
	Boise Ck.	8,247	5.5	7.3	10.2	1.5	2.3	**5.4**	4	6	7	1	2	**4.0**
	Horse Draw	14,717	4.0	-	0.1	-	-	**0.8**	2	-	1	-	-	**0.6**
	Johns.-Truj.	20,930	-	1.0	-	-	-	**0.2**	-	1	-	-	-	**0.2**
	Winter Valley	1,630	-	-	-	-	0.5	**0.1**	-	-	-	-	1	**0.2**
Subtotal White River		**63,395**	**11.1**	**17.3**	**14.1**	**3.6**	**4.3**	**10.1**	**7**	**12**	**11**	**2**	**4**	**7.2**
All BLM Lands		**731,909**	**91.5**	**77.1**	**65.4**	**70.2**	**86.4**	**78.1**	**99**	**96**	**94**	**86**	**128**	**101**

"-", no flights during that timeframe.

APPENDIX C: BIOLOGICAL ASSESSMENT FOR INFORMAL SECTION 7 CONSULTATION

BIOLOGICAL ASSESSMENT FOR INFORMAL SECTION 7 CONSULTATION
U. S. DEPARTMENT OF AGRICUTLURE, ANIMAL AND PLANT HEALTH INSPECTION SERVICE, WILDLIFE SERVICES – COLORADO PROGRAM
For Predator Damage Management environmental assessment

July 29, 2016

The Wildlife Services (WS) Colorado program requests an informal Section 7 Consultation for federal listed threatened and endangered species in Colorado for a predator damage management (PDM) program to protect livestock, wildlife species of management concern, and human safety. We are preparing an environmental assessment to examine issues, alternatives and environmental consequences of PDM to protect these resources. The WS Colorado Program most recently completed an environmental assessment for predator damage management in 2005. The enclosed analysis includes references to previous informal Section 7 consultations, portions of the environmental assessment to provide scope and effect, and an appendix with descriptions of methods that would be used during PDM.

WS is a federal program within the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) with responsibility to manage wildlife damage to protect agriculture, human health and safety, natural resources and property. This responsibility is conducted under the Act of March 2, 1931, as amended (7 USC 426), and the Act of December 22, 1987 (7 USC 426c). The program manages damage by providing technical assistance, operational management, educational programs, and liaison with state and federal regulatory agencies for permits, technical information, and seminars and workshops. Activities conducted by WS are closely aligned with management goals of the Colorado Department of Agriculture, Colorado Parks and Wildlife and the U. S. Fish and Wildlife Service (USFWS).

WS has been conducting PDM activities in Colorado since 1916. These wildlife damage management activities continue to change and evolve to reflect societal values and minimize impacts to people, wildlife and the environment. Moreover, the science of wildlife management continuously evolves as new information becomes available in scientific publications. We continuously review and incorporate this new information into program activities and research conducted by the National Wildlife Research Center, the research branch of Wildlife Services. PDM is very complex, often brings strong emotional response from the public and can take years to produce observable effects. Conflicts involving predation on livestock or wildlife species of concern are contentious with some members of the public because methodologies they want implemented may be less effective, harmful to the environment, or are harmful to resources which other members of the public want protected. Some of these conflicts among user groups may actually be harmful to some threatened or endangered species.

Section 7 of the Endangered Species Act of 1973, as amended ((ESA) 16 USC 1531-1543), requires each Federal agency to ensure that its actions will not jeopardize the continued existence of listed species or destroy or modify such species' critical habitat. If one or more protected species may be affected within the area of a proposed action, then the agency must determine whether and how the action will or could potentially affect such species. If a "may affect" determination is made, the agency must consult with the USFWS to determine whether the action is likely to adversely affect or jeopardize the continued existence of the species. If USFWS determines that the proposed action is likely to adversely affect or jeopardize the continued existence of a protected species, the agency must avoid or mitigate the proposed action so that the adverse action is avoided or the adverse impact is reduced to an acceptable level. This Biological Assessment considers all Federal listed threatened and endangered (T&E) species, experimental populations, and proposed and candidate species from the Federal list and determines whether or not PDM will have an effect on these species.

The WS Colorado Program is part of the national WS program, which has been previously reviewed under a formal consultation between WS and USFWS, resulting in a biological opinion (BO) from USFWS in 1992. Changes to WS Colorado PDM activities and new T&E Species listings prompted this request for an updated Section 7 consultation. Since the 1992 BO, WS in Colorado has consulted under Section 7 of the ESA with USFWS for the aquatic rodent damage management (ARDM) program (WS 2003, USFWS 2003), for potential impacts to Canada lynx from the WS PDM program (WS 2009, USFWS 2009) and for a programmatic review of the WS Colorado program activities in (WS 2011, USFWS 2011).

Populations of listed species designated as Non-essential experimental populations (NEPs) are treated as "proposed" for listing for purposes of Section 7 consultation when they do not occur on National Wildlife Refuge (NWR) System or National Park Service (NPS) property in their designated NEP area. Changes in distribution of NEP species and new listings warrant a review to analyze possible impacts from WS Colorado PDM program activities. When an individual from an NEP travels outside of the designated area, its status changes to that of an endangered species until USFWS returns it to the experimental range or increases the experimental range to include the new area where the animal has been found. For example, California condors from the NEP in northwestern Arizona and de-listed gray wolves from Idaho, Montana, and Wyoming have wandered into Colorado where they are listed as endangered.

Also, new species have been listed for protection under the ESA requiring a review of agency actions and potential effects on those species. As a result of these changes, WS Colorado has made the decision to conduct this Section 7 consultation with the USFWS to ensure that the ongoing PDM program would not have an adverse effect on T&E species. In most cases, the PDM methods used and species affected have not changed since the 2011 Biological Assessment and WS continues to abide by that consultation. This Biological Assessment and correspondence from the USFWS will be included in NEPA documents prepared by WS Colorado program and will provide WS guidance for PDM. This consultation is also being conducted to distribute to WS personnel to ensure that all personnel are aware of the T&E species in the State, especially those recently listed, and to reemphasize the mitigation measures in place for species which could be affected by PDM. This Biological Assessment covers all WS PDM activities, including species and methods that have not been previously discussed or used in Colorado, but could potentially be used in the future.

DESCRIPTION OF PROPOSED ACTION

Scope and Effect

Wildlife Services has long-standing statewide programs to protect livestock from predation and occasionally is requested to conducted PDM projects to protect native wildlife from predation. Livestock, especially sheep and cattle, are depredated by coyotes, black bears, mountain lions, golden and bald eagles, red foxes, bobcats, and feral or free ranging dogs. Smaller livestock, such as poultry and domestic waterfowl are reported to be depredated by swift fox, red fox, red-tailed hawks, skunks, raccoons, bobcats, black bears, and mountain lions. Less abundant livestock including alpacas, horses, and goats are depredated by coyotes, feral or wild dogs, mountain lions and black bears. Wildlife Services has been requested to protect threatened or endangered species (e.g. Gunnison sage grouse, black-footed ferret, piping plovers, least terns) from predation. Other wildlife species we have been requested to protect are species of management concern that are declining in abundance locally (e.g. mule deer). We have also been consulted about predation on other wildlife species in local situations due to mountain lion predation on big horn sheep and coyote and mountain lion predation on elk. Less frequently, Wildlife Service is requested to assist homeowners and local communities and governments when wild predators depredate companion animals or attack or threaten to attack people. We have become involved when coyotes, red fox or mountain lions kill pet dogs and cats. WS has also become involved when wild carnivores, especially bears, lions and coyotes, have attacked or threatened humans.

Protecting livestock from Predation

WS conducts PDM to protect livestock from predation statewide on public, private and tribal lands. For the federal fiscal years (FYs) 2010 to 2015 (FY 2011 = October 1, 2010 to September 30, 2011), WS had agreements (Work Initiation Documents) in place to conduct livestock protection by managing predation on 4.958 million acres of land or 7.4% of the Colorado land area. Private land comprises 2.967 million acres or 60% of land where WS Colorado conducts PDM for livestock protection. Other land types where PDM is conducted by WS Colorado for livestock protection include 197,771 acres of state lands, 2,541 acres of tribal lands and 1.791 million acres of Bureau of Land Management or Forest Service lands. Colorado can be divided into three different regions based on the primary livestock protected, land types worked, and density and species diversity of predators (Table 1).

<u>Western Slope</u>: PDM for livestock protection on the western slope primarily protects sheep from coyote, black bear and mountain lion predation. Sheep are primarily raised on range that requires moving every few days to new grass to graze. Additionally, some ranches raise cattle, goats, alpacas, horses and donkeys. An annual average of 9.2 staff years were spent by field employees reducing predation on livestock and wildlife species of management concern. Wildlife Services expends the greatest effort protecting livestock from January to May using aerial predator damage management to remove coyotes from grazing and lambing grounds on the western slope. Corrective management action to protect newborn lambs is most intensive during mid-April to early June. Management tools used by Wildlife Services for corrective management action includes aerial predator damage management, calling and shooting, decoy dogs to attract and shoot territorial coyote pairs, and trapping with foot hold traps, snares and M-44's[19]. Livestock producers use guard dogs, herders, range riding, habitat management (e.g., brush removal), husbandry and shooting to protect livestock during this period. After June, predation on livestock from coyotes generally declines due to removal of territorial coyote pairs around the lambing and grazing grounds, and coyotes switching to newly available deer fawns, rabbits and their young, rodents and other wildlife for food. While coyote predation on lambs and sheep declines, bear predation accelerates greatly during the summer on the western slope. Lion predation on lambs and sheep occurs less often than bear or coyote predation. Bear and lion predation corrective action usually requires using hounds to track, tree or corner depredating animals. Shooting with night-vision is another common method to remove bears and lions killing livestock on the western slope. Ranches or grazing allotments on the western slope may be all private land, a mix of public and private land or all public land. Ranches and grazing allotments on the western slope tend to be large, covering thousands or tens of thousands of acres due to the need to graze lands lightly to avoid excessive grazing. This form of livestock production keeps large tracts of habitat intact.

<u>Southeastern Colorado</u>: Livestock protection activities in southeastern Colorado primarily protect calves from coyote predation. An annual average of 1.2 staff years were spent by field employees reducing predation on livestock. Wildlife Services expends the greatest effort protecting cattle from February to May using aerial predator damage management to remove coyotes from calving grounds in southeastern Colorado. Also, there are several types of bird production operations raising domestic chickens, ducks, geese, ostriches and other small farm animals (e.g., rabbits) that are depredated by coyotes, red fox, bobcat and raccoons. Corrective management action to protect newborn calves is most intensive during March through April. Management tools used by Wildlife Services for corrective management action includes aerial predator damage management, calling and shooting, shooting, decoy dogs to attract and shoot territorial coyote pairs, and trapping with foot hold traps, snares and M-44's[1]. Livestock producers use guard dogs, range riding, grazing pastures with less predation, fencing and shooting to protect livestock during this period. Some smaller livestock producers can pen livestock at night to reduce predation. Bird and small animal production ranches generally using fencing, night penning, bringing animals in at night, cage traps, husbandry and shooting to manage predation by coyotes, foxes, bobcats and raccoons. Bear and lion predation on livestock is common in southeastern Colorado but less frequent than the western slope. Ranches and grazing allotments in southeastern Colorado often are entirely private land. Some ranches or grazing allotments are a mix of private or public land. Public-land-only ranches or grazing allotments are uncommon. Ranches and grazing allotments in southeastern Colorado tend to be smaller, covering several hundred to several thousand acres. A few ranches are larger covering tens of thousands of acres, but these are uncommon.

<u>Northeastern Colorado</u>: Livestock protection activities in northeastern Colorado primarily protect calves from coyote predation. However, there is a mix of livestock raised in northeastern Colorado, including sheep on range or pasture, alpaca on pasture, and various livestock in feedlots. An annual average of 0.75

[19] Use of foot hold traps, snares and M-44's for livestock protection is limited to private land only.

staff years were spent by field employees reducing predation on livestock. Wildlife Services expends the greatest effort protecting cattle and sheep from February to May using aerial predator damage management to remove coyotes from calving and lambing grounds in northeastern Colorado. Corrective management action to protect newborn calves and lambs is most intensive during March through April. Management tools used by Wildlife Services for corrective management action includes aerial predator damage management, calling and shooting, shooting, decoy dogs to attract territorial coyote pairs, and trapping with foot hold traps, snares and M-44's[1]. Livestock producers use guard dogs, range riding, grazing pastures with less predation, fencing, habitat management, husbandry and shooting to protect livestock during this period. Some smaller producers can pen livestock at night to reduce predation. Bear and lion predation on livestock is uncommon in northeastern Colorado, but it does occur. Ranches and grazing allotments in northeastern Colorado often are entirely private land. Some ranches or grazing allotments are a mix of private or public land. Public-land-only ranches or grazing allotments are much less common. Ranches and grazing allotments in northeastern Colorado tend to be smaller, covering several hundred to several thousand acres. There are also some small livestock producers raising a few animals for personal use or specialty markets (e.g., wool, food). There are a few ranches covering more than 10,000 acres, but these are uncommon.

Table 1. Counties by regions of Colorado where predation management activities were conducted by the Wildlife Services program of the United State Department of Agriculture, Animal and Plant Health Inspection Service to protect livestock or wildlife species of management concern from predation, FY2010 – 2015.

Western Slope	Northeast	Southeast
Archuleta	Arapahoe	Baca
Delta	Cheyenne	Crowley
Dolores	Elbert	Douglas
Eagle	Morgan	El Paso
Garfield	Morgan	Fremont
Grand	Washington	Huerfano
Gunnison	Weld	Huerfano
Gunnison		Kiowa
Hinsdale		Las Animas
Jackson		Las Animas
La Plata		Lincoln
Larimer		Otero
Mesa		Prowers
Moffat		Pueblo
Montrose		Teller
Ouray		
Pitkin		
Rio Blanco		
Routt		
San Juan		
San Miguel		

Aquaculture also occurs in Colorado. Requests for assistance for predation on food fish are less common. However, WS Colorado has been requested by producers to provide technical assistance on farm raised trout, catfish and other food fish. Predation on farm raised fish is generally from meso-carnivores or migratory birds.

WS works with, or could potentially work with, several species of wildlife that depredate livestock. The species that WS Colorado could possibly encounter during PDM includes a few state managed mammals and a handful of migratory birds. These "possible" species include carnivorous and omnivorous predatory mammals (canids, felids, black bear, raccoon, mustelids, opossum, and feral dogs and cats) and a small number of birds (gulls and raptors). The abundance of PDM operations for many of these "possible" species to protect livestock or wildlife species of management concern varies widely. From FY2011 to FY2015, WS in Colorado conducted PDM activities (direct control and technical assistance) involving 11 different predatory species (Table 2).

Table 2. Animal species taken by Wildlife Services Colorado while conducting livestock protection programs, FY2011-2015.

	Target Species		Non-Target Species	
Species	Killed, total 5-years	Killed, annual average	Killed	Released, unharmed
Badger	5	1		
Black Bear	349	70		
Bobcat	6	1		
Coyote	9,300	1,860		
Crow	8	2		
Feral cat	1	0		
Mountain lion	49	10		1
Raccoon	76	15	1	
Red Fox	278	56	1	
Swift Fox	4	1		
Striped Skunk	10	2		
Raven			1	

Livestock producers implement most non-lethal methods and a few lethal methods to protect their livestock or farm raised fish. WS Colorado is often requested to abate predation when specialized skills are required or legal limitations exist. Whereas WS Colorado uses non-lethal methods where appropriate or for demonstration, we often implement lethal methods to abate predation where producers are unable to resolve, special skills are required or legal restraints limit methods producers may use. There are a number of methods used to capture or kill predatory species depredating livestock (Table 3). The methods used to capture or take the predatory animals were combined due to similarity and summarized. Examples of combining methods would be shooting coyotes from a fixed-wing aircraft versus a helicopter into a category called aerial. Similarly, the category for taking animals with firearms includes animals which were shot, called into range and shot, decoyed with dogs and shot, treed or corned with dogs and shot, or located with night-vision goggles or thermal imaging and shot. We analyzed take of predatory species depredating livestock as well as non-target species taken unintentional and their fate. In summary, WS Colorado killed 10,080 target predatory animals to protect livestock over the 5-year period with only 4 non-target animals captured. One of the non-target animals captured in a neck snare was released alive unharmed (Table 2 and 3).

Predator animals may also be hazed with shooting or dogs. This non-lethal approach can be effective at times for stopping a predation incident. This approach was used for specific predation incidents to disperse 2 mountain lions, 5 black bears and 16 coyotes during the 5-year period.

Protecting Wildlife from Predation

PDM involves several species of predators in Colorado (Table 2), but especially the coyote, black bear and red fox. Predator damage management activities are for the protection of livestock and some wildlife (e.g., mule deer, Gunnison’s sage grouse, black-footed ferret, piping plover, least tern) in Colorado. Requests to protect wildlife species of management concern are less frequent and may not occur every year. The T&E species that have the greatest chance of being affected by PDM programs are the potential appearance of gray wolves or California condors in the State.

Table 3. Methods used by Wildlife Services Colorado to capture or kill predatory animals and non-target animals to protect livestock, FY2011-2015. Numbers in parentheses are percentages of total take.

Method Used	Target species, killed	Non-target species killed	Non-target species released alive
Aerial[a]	6,345 (63%)		
Firearms[b]	2,681 (27%)		
M-44	83 (1%)	2 (<1%)	

Snare, foot	7 (<1)		
Snare, neck	287 (3%)	1 (<1%)	1 (<1%)
Trap, cage	46 (<1%)		
Trap, foot-hold	631 (6%)		
Dens, Gas cartridge	7 (<1%)		
TOTAL	10,080	3	1

a. Aerial is comprised of shooting from fixed-wing aircraft and helicopters.
b. Firearms summarized taking by shooting, shooting aided by night-vision or thermal imaging, calling and shooting, using dogs to tree or corner then shoot, decoying with dogs followed by shooting.

Predatory species involved in Predator Damage Management

PDM activities conducted by WS Colorado from FY2011 through FY2015 involved 22 species depredating, injuring, or threatening 26 agricultural or natural resources (Table 4). Predatory animals were comprised of 9 mammal and 13 bird species. All the predatory species are common or abundant in Colorado, though some species are infrequently or rarely seen by people due to the animal's nocturnal or secretive lifestyle. An example of a common animal which is rarely seen in Colorado would be a mountain lion. Other wildlife and feral species depredate agricultural and natural resources but WS Colorado did not receive any requests for assistance involving these other depredating species during this five year period.

WS has also previously worked with, or could potentially work with, several species of wildlife that come into conflict with human activities, including mammals (coyotes, foxes, mountain lion, bobcat, black bear, raccoon, ringtail, mink, river otter skunks, opossum), feral animals (feral swine, feral or wild dogs, and feral cats), birds (grebes, pelicans, cormorants, herons, gulls, raptors, corvids) and a few fish. PDM operations for many of these "possible" species have historically been provided by WS or have been conducted by other WS programs and have potential in Colorado. Technical assistance projects for these species are not considered a federal action and, therefore, would be excluded from PDM activities. With the exception PDM for bald and golden eagles in Table 1, all species have been relatively common. People requesting information for PDM involving T&E species such as Canada lynx and gray wolf (should a problem arise) or eagles are told to consult with USFWS for any necessary permit should any action such as hazing, nest removal, or lethal management actions be required to resolve the problem.

Table 4. Wildlife and feral animals reported to Wildlife Services – Colorado program that depredated, injured or threatened agricultural and natural resources in Colorado from Federal Fiscal Year 2011 through 2015.

Resource	Predator	No. of Incidents[A]
Catfish, trout, food fish (farm raised)	Cormorant, Double-crested	9
	Crow, American	1
	Gulls	22
	Heron, Great Blue	15
	Kingfisher, belted	3
	Merganser, Common	2
	Night Heron, Black-crowned	9
	Pelican, White	4
	Raven, Common	1
	Bear, Black	1
Game birds (pen raised)	Badger	1
Elk (pen raised)	Mountain lion	4
Exotic or native large mammals, fallow deer (pen raised)	Coyote	1
	Mountain lion	3
Alpaca	Mountain lion	7
Cattle (cows, calves)	Bear, Black	25
	Bobcat	1
	Coyote	115
	Dog, Feral	5
	Mountain lion	14
	Raccoon, Stripped skunk	2
Donkeys or burros	Mountain lion	2
Goats (meat, mohair, other)	Crow, American	1
	Bear, Black	19
	Coyote	23
	Dog, Feral	1
	Mountain lion	53
Horses	Coyote	11
	Dog, Feral	1
	Mountain lion	11
Llamas	Bear, Black	2
	Mountain lion	6
Mules	Mountain lion	1
Rabbits (domestic)	Raccoon	2
Sheep (ewes, rams, lambs)	Bear, Black	858
	Bobcat	2
	Coyote	925
	Dog, Feral	1
	Mountain lion	124
	Red Fox	63
Swine (domestic)	Bear, Black	2
	Dog, Feral	3
	Mountain lion	1

Chickens	Bear, Black	5
	Bobcat	2
	Coyote	6
	Mountain lion	3
	Raccoons	6
	Fox, Red	12
	Skunk, Striped	1
	Hawk, Red-tailed	1
Ducks (domestic)	Coyote	2
	Fox, Red	3
Geese (domestic)	Coyote	1
Ostrich (domestic)	Coyote	1
Pea Fowl	Mountain lion	1
Pigeon (domestic)	Coyote	1
	Bear, Black	1
	Fox, Red	1
	Mountain lion	2
	Raccoons	1
Trout and other fish (wild)	Raccoons	1
	Cormorant, Double-crested	8
	Crow, American	1
	Gulls	13
	Heron, Great Blue	13
	Kingfisher, belted	5
	Merganser, Common	2
	Night Heron, Black-crowned	3
	Pelican, White	6
	Raven, Common	1
Least Tern (T&E Species)	Gulls	3
Piping Plover (T&E Species)	Gulls	3
Mule Deer	Coyote	1
Pets (cats, dogs)	Coyote	5
	Fox, Red	2
	Mountain lion	2
	Raccoon	5
	Skunk, Striped	1
Zoo animals	Mountain lion	1

A. An incident can involve one or more animals.

From FY2011 to FY2015, WS worked with 3 species of mammals and 1 species of bird where lethal take averaged more than 100 annually and could be involved with PDM. A species may have been taken more than 100 times but could be taken to protect other resources, such as human safety at airports. Those species lethally taken more than 100 times annually over the 5 years to protect agricultural or natural resources from predation were coyotes and raccoons.

PDM involves several species of predators in Colorado (Table 4), but especially the coyote, black bear and red fox. The T&E species that have the greatest chance of being affected by PDM programs are larger mammals such as Canada lynx and potentially the appearance of a gray wolf or California condor in the

State. Canada lynx in Colorado live at higher elevations in spruce-fir forests where their primary food source (i.e. snowshoe hare) is found. Few livestock graze in these areas, and WS conducts very little PDM in lynx habitat. Whereas it is possible that WS Colorado would encounter a lynx at lower elevations, we have captured none since their reintroduction while conducting PDM. Another T&E species WS Colorado would encounter while conducting livestock protection would be Gunnison sage grouse and we are unlikely to affect them.

PDM Methods Available for Use

A variety of methods are used by WS personnel in PDM (Table 5, Appendix A). These methods involve three main strategies: resource management (habitat modifications and cultural practices such as night-penning, guard animals, and carcass removal), physical exclusion (netting, conventional and electrical fencing), and wildlife management (foot-hold and cage traps, snares, aerial predator damage management, M-44 devices, hand capture, scare devices such as pyrotechnics and scarecrows, and immobilization drugs such as ketamine compounds). Some methods or tactics are used for many different predator species (e.g., foot hold traps, shooting), and others are specific to individual species (e.g., culvert traps for bears). WS conducts direct control activities involving take on private lands only where signed *Work Initiation Documents* have been executed. WS conducts direct control activities on municipal, county or other government lands only if *Work Initiation Documents* or Work Plans are in place covering the government land. These agreements and work plans list the intended target animals and the methods to be used.

Table 5. Summary of methods used by WS operationally for predator damage management and their potential to negatively affect T&E species.

Method	Direct PDM use by WS	Species Targeted	T&E Spp. Potentially Affected	Negative Affect	SOPs to Reduce Affect
Resource Management Methods					
Guard Dogs	Potential	Canids	M/B	Min	No
Habitat Management*	Potential	All	All	Neg	Yes
Physical Exclusion					
Fencing	Potential	Canids, raptors	M/B	Min/Neg	Yes
Wildlife Management					
Frightening Devices					
- Harass/Pyrotechnics/Propane Cannon	High	All	M/B	Min	Yes
- Elec. Sirens/Lights	Low	Canids	M	Min	Yes
Electrical barriers	Potential	Canids, swine	A/F	Min	Yes
Capture/Take Methods					
- Foothold Trap	Medium	Canids, meso-carnivors	M/B	Neg	Yes
- Cage Traps	Medium	All	M/B/R/A/F	Min	Yes
- Cannon Nets/Net Gun	Low	Birds	None	0	-
- Drive Trap	Low	Waterfowl	None	0	-
- Raptor Traps, e.g. Bal Chatri	Medium	Raptors	B	Min	Yes
- Pole Traps (modified foothold for perching bird)	Low	Raptors	B	Neg	Yes
- Snares (body, foot)	Medium	Mammal predators	M/B	Neg	Yes
- Snares (break-away)	Potential	Mammal predators	P	Min	Yes
- Quick Kill	Low	Meso-carnivores	M/B/F	Neg	Yes
- Denning	Medium	Canids	None	0	-
- Shooting	High	All	M/B	Min	Yes
- Aerial Shooting	High	Canids, swine	M/B	Min	Yes
- Dogs	High	Canids, meso-carnivores	None	0	-
- Nest/Egg Destruction	Low	Corvids	None	0	-
- Electrofishing/Gill Nets	Potential	O	A/F	Neg	Yes
- Chemical Immobilization/Euthanasia	Low	All	None	0	-
Chemical Toxicants					
- Sodium Cyanide	Medium	canids	M/B	Neg	Yes
- DRC-1339	Medium	Corvids, gulls	B	Min	Yes
- Gas Cartridge (largel)/Fumigants	Medium	Canids	M/R/A	Neg	Yes
Chemosterilants/Contraception	Potential	Canids	None	0	-

* - Requires site-specific consultation with USFWS where T&E species or their habitat is present.

Methods Used by WS - High = Frequently Year-round, Medium = Frequently Seasonally/Infrequent Year-round, Low = a few times a year to rarely, Potential = not used but could be.

T&E Spp. Affected - M - mammals, B - birds, R - reptiles, A - amphibians, F - fish, I - invertebrates, P – plants

PDM methods used by WS to alleviate predation damage have varying potential to affect T&E species, and are summarized in Table 5 along with the level of use. WS direct operational PDM efforts for different wildlife can include the use of any PDM methods, but primarily involve site-specific "hands-on" wildlife management techniques. This is primarily because land managers can and do conduct their own resource management and physical exclusion techniques. Many of the methods in PDM that are used by WS are used lethally. Some of the nonlethal PDM techniques such as foothold, cage and drive traps, foot and neck snares, immobilization drugs, and hand capture can result in a lethal take if, as a result of capture, the animal is euthanized using methods such as Beuthanasia-D®, cervical dislocation, a gunshot to the brain, or asphyxiation with CO_2. Other non-lethal methods used in PDM have minimal to no impact on T&E species in most circumstances and these would include hazing methods (e.g,. lasers, pyrotechnics, distress calls, mylar tape and eyespot balloons, effigies), exclusion (e.g., netting, sealing broken doors or windows) or cultural methods (removing anthropogenic food sources).

WS is prudent and professional with its use of the different methods, especially those listed in Table 2 that could have the potential to affect T&E species in their occupied areas. From FY2011 to FY2015, WS did not take any T&E species incidentally with the methods in Table 2. WS presently uses an integrated PDM approach which employs a variety of methods for managing wildlife damage. Integrated PDM allows WS personnel greater flexibility and more opportunity to tailor an effective damage management strategy for each specific problem that is encountered. In selecting control techniques, consideration is given to the type, magnitude, duration, frequency, and location of damage. Consideration is also given to the status of potential non-target species, especially T&E species, and social considerations. The decision-making steps taken by WS personnel when addressing wildlife damage are described in the "WS Decision Model" which is discussed in great detail in WS (2003, 2005 and 2013) and Slate et al. (1992).

All PDM methods have limitations and some can potentially affect T&E species. Table 5 summarizes the potential PDM methods used by WS in Colorado, the frequency of their use, the species they are intended to target, and potential to affect T&E species. When WS Specialists receive a request for assistance, they consider a wide range of methods to use and their limitations as they apply the decision making process to determine what method(s) to use to resolve a wildlife damage problem (Slate et al. 1992). The effect that PDM methods have on T&E species can range from having none to a highly negative effect. The potential negative effects are offset with standard operating procedures (SOPs) and other measures to reduce the risks associated with them. When these measures are in use, the risk of an impact on the T&E species is likely to be very minimal or avoided. It should be noted that several PDM methods also have a positive effect for some species by reducing predators or competition with the species targeted. For example, the use of DRC-1339 to take cowbirds in the range of the southwestern willow flycatcher would have a positive impact on the flycatcher by reducing nest parasitism. Appendix A gives descriptions and SOPs to minimize or nullify potential take for all PDM methods being used by WS, but not all of these methods are currently being used by WS- Colorado.

ANALYSIS OF POTENTIAL IMPACTS ON THREATENED AND ENDANGERED SPECIES

A current list of threatened and endangered (T&E) species was obtained from USFWS for Colorado in April 2016 (Table 6). Of the species and subspecies currently listed under provisions of the ESA, excluding those listed but not in Colorado, 15 species are federally listed as endangered in Colorado: 8 animals and 7 plants. Eighteen species in Colorado are listed as federally threatened: 9 animals and 9 plants. Following WS's analysis section will be a section specifically listing the SOPs that WS will adhere to for the protection of T&E species in Colorado.

The location, habitat, and diet of T&E species is important information to determine impacts that PDM may have. PDM activities conducted by WS for mammalian and avian predators is most commonly conducted in agricultural fields, open forests, grasslands, rangelands, and urban areas; therefore, these activities have little or no impact to wetlands and dense forests where some T&E species are found.

It should be noted that the grizzly bear (*Ursus arctos horribilis*) and gray wolf are listed in Colorado, but the grizzly bear does not occur within the state and was not included in Table 6. Grizzly bear populations will not be discussed in this Biological Assessment because WS will have ***no effect*** on them with PDM since they are not present. However, gray wolves are a more frequent visitor and likely will establish breeding individuals in the not so distant future. Individuals from the gray wolf and California condor NEPs have come into Colorado where they are considered endangered species while they are outside their NEPs or de-listed range. Until USFWS return them to their NEP range or de-listed range or expands the experimental range to include the new location they are considered an endangered species. Gray wolves have been entering Colorado more frequently in recent years. In summary, individual gray wolves, including the northern Rocky Mountains and Mexican subspecies, and California condors from their NEPs have the potential for coming into the State and will be discussed later in the biological assessment under NEP conferencing. If any of these species' status changes, WS would request a separate consultation.

Table 6. Colorado Federally listed endangered and threatened species, their location, habitat, diet, and potential for impact from PDM.

SPECIES	Scientific Name	Status	Locale	Habitat	Diet**	PDM
MAMMALS						
Preble's Meadow Jumping Mouse	*Zapus hudsonius preblei*	T	Central-North central	W	Gi	-, 0, +
New Mexico Meadow Jumping	*Zapus hudsonicus luteus*	E	Las Animas	GW	GI	-, 0, +
Black-footed Ferret* NEP	*Mustela nigripes*	E	Statewide	R	S	-, 0, +
Canada Lynx	*Lynx canadensis*	T	West, Central Mountains	F	SI	-, 0, +
BIRDS						
Gunnison Sage-Grouse	*Centrocercus minimus*	T	Central-Westcentral	R	GI	-, 0, +

Whooping Crane (not listed for CO)	*Grus americana*	E	East	R	Gis	-, 0, +
Piping Plover	*Charadrius melodus*	T	East	W	I	-, 0, +
Least Tern (Interior Population)	*Sterna antillarum*	E	East	W	AI	-, 0, +
Yellow-billed Cuckoo (Western pop.)	*Coccyzus americanus*	T	West	F	I	0
Mexican Spotted Owl	*Strix occidentalis lucida*	T	West	F	S	0
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E	Southwest	F	I	-, 0, +
FISHES						
Greenback CutthroatTrout	*Oncorhynchus clarki stomias*	T	Central	LSg	AI	-, 0, +
Colorado Pikeminnow	*Ptychocheilus lucius*	E	West	Lg	A	0
Humpback Chub	*Gila cypha*	E	West	LSg	A	0
Bonytail Chub	*Gila elegans*	E	West	LSg	A	0
Razorback Sucker	*Xyrauchen texanus*	E	West	Lg	A	0
INVERTEBRATES						
Uncompahgre Fritillary Butterfly	*Boloria acrocnema*	E	Southwest	F	N	0
Pawnee Montane Skipper	*Pseudocopaeodes eunus obscurus*	T	Douglas/Jefferson/Park/Teller	G	N	0
PLANTS						
Mancos Milk-vetch	*Astragalus humillimus*	E	Montezuma	R	-	0
Osterhout Milk-vetch	*Astragalus osterhoutii*	E	Grand	R	-	0
Clay-loving Wild Buckwheat	*Eriogonum pelinophilum*	E	Delta/Montrose	R	-	0
Penland Alpine Fen Mustard	*Eutrema penlandii*	T	Lake/Park/Summit	RW	-	0
Colorado Butterfly Plant	*Gaura neomexicana var. coloradensis*	T	North Central	RW	-	0
Pagosa Skyrocket	*Ipomopsis polyantha*	E	Archuleta	FG	-	0
Dudley Bluffs Bladderpod	*Lesquerella congesta*	T	Rio Blanco	R	-	0
Knowlton Cactus	*Pediocactus knowltonii*	E	La Plata	R	-	0
Parachute Beardtongue	*Penstemon debilis*	T	Garfield	R	-	0
Penland Beardtongue	*Penstemon penlandii*	E	Grand	R	-	0
North Park Phacelia	*Phacelia formolusa*	E	Jackson/Larimer	R	-	0
DeBeque Phacelia	*Phacelia submutica*	T	Garfield/Mesa	R	-	0
Dudley Bluffs Twinpod	*Physaria obcordata*	T	Rio Blanco	R	-	0
Colorado Hookless Cactus	*Sclerocactus glaucus*	T	Delta/Garfield/Mesa/Montrose	R	-	0
Mesa Verde Cactus	*Sclerocactus mesae-verdae*	T	Montezuma	R	-	0
Ute Ladies'-tresses	*Spiranthes diluvialis*	T	Northwest-North central	RW	-	0, +

* - believed extirpated

**Diet - Capitals = large proportion of diet - Lower case = small proportion of diet.

STATUS
E - Endangered
T - Threatened
P - Proposed

HABITAT
F - Forests/riparian borders
G - Grassland/meadow
R - Range/sage/high desert
W - Wetland/marsh/sandbar
L - Lakes, Rivers
S - Springs/creeks/ponds
g – gravel bottom

DIET
A - Aquatic- fish/invertebrates/plants
G - Grains/grass/brush/seeds
L - Large Vertebrates
M - Mast/fruit & nuts
N - Nectar/sap
S - Small vertebrates (i.e. rodents, birds)
C- Carrion

PDM - Impacts
(-) - Negative
0 - none
(+) - Positive

Some species are listed in Colorado or particular counties from the standpoint of water depletions in river basins. All species listed for the western slope in the Upper Colorado River and San Juan River Basins are listed in the State because they occur in some counties, but are listed in some counties from the standpoint of water depletions. Most species associated with the Platte River in Nebraska which could be affected by water depletions in the North and South Platte, and Laramie River Basins in Colorado, including the whooping crane, pallid sturgeon (*Scaphirhyncus albus*), and western prairie fringed orchid (*Platanthera praeclara*) do not occur in Colorado. The only exception is the whooping crane which has been documented in some counties of eastern Colorado, but rarely. Only those species found in the State will be discussed in this Biological Assessment; the others will not because PDM has ***no effect*** on water depletions, specifically regarding the two species in Nebraska.

MAY AFFECT SPECIES

WS has the potential to impact some T&E species, but this potential is low when SOPs of the WS PDM program are implemented. The following are species that could be affected by WS PDM. WS believes that formal consultation for these species be initiated/reinitiated as all were considered in the 1992 consultation between USFWS and WS (USDA 1992). However, new programs that were not conducted in 1992 currently have the potential to affect some of them.

Black-footed Ferret: Endangered (32 FR 4001; March 11, 1967) without critical habitat, NEP population designated (61 FR 11320, March 20, 1996)

Black-footed ferrets were once found in Colorado among black- and white-tailed and Gunnison's prairie dog colonies, their principal food sources. Verified sightings in Colorado, however, have been rare with the last verified sighting in 1946. Ferrets were likely always scarce throughout the West and Colorado, but declined with the westward expansion of people and agriculture which reduced their principle habitat, prairie dog towns. Black-footed ferrets are closely associated with prairie dogs which declined dramatically from temporary and permanent conversion of native grasslands to crops, poisoning and disease (USFWS 2013). Prior to the establishment of the Moffat/Rio Blanco County BLM NEP, black-footed ferrets were probably extirpated in Colorado as a result of intensive prairie dog poisoning campaigns. Prairie dog towns were significantly reduced by over 95% by the mid-20th century across the United States which inherently reduced the ferret population. The last population of ferrets was discovered in 1981 in Meeteetse, Wyoming. As a result of a canine distemper outbreak in 1985, and probable sylvatic plague, the population of over 100 ferrets was reduced to about 20. The remaining ferrets were taken into captivity and used to establish a breeding colony. Over the next year, 18 of the ferrets taken into captivity survived the quarantine period. The breeding colony was successful and used to establish several breeding colonies at facilities throughout the country, including several zoological gardens. These have produced thousands of ferrets, many of which have been released into 9 NEPs. The likelihood of discovering another wild population today is very minimal.

The primary methods that were considered to have the potential to adversely impact ferrets in the 1992 BO were traps without pan-tension devices used in and around prairie dog towns for predator damage management, primarily coyotes, and control of prairie dogs with zinc phosphide baits and fumigants, from primary and secondary poisoning as well as the removal of their prey base. Further analysis by USFWS has restricted the risk of primary or secondary poisoning of black-footed ferrets to fumigants, as stated in the Safe Harbor Agreements. These risks are limited to western Colorado outside of the block-cleared area, as discussed below. USFWS determined that the removal of predators, though, including those removed with traps fitted with pan-tension devices that preclude capture of ferrets, could have beneficial impact on ferrets by reducing direct predation and the spread of disease. The 1992 BO provided Reasonable and Prudent Alternatives (RPAs) for WS to follow to preclude jeopardy. USFWS provided an Incidental Take Statement in the 1992 BO, but stated that no incidental take by WS, guided by the RPAs, was anticipated. WS in Colorado has abided by the RPAs established in the 1992 BO and has never had any known effect on ferrets. In addition, pan tension devices are used on foothold traps for PDM near prairie dog towns that preclude the capture of ferrets. WS worked with Colorado Parks and Wildlife (CPW) to provide protection for black-footed ferrets from predators (coyotes, badgers, and red fox) in the northwestern Colorado NEP which will be discussed under NEP populations below.

WS Colorado has taken a more active role since 2014, working with CPW and the USFWS to re-establish populations of black-footed ferrets in black-tailed prairie dog towns of eastern Colorado. WS treats prairie dog towns with deltamethrin, a pesticide registered with Colorado Department of Agriculture to kill fleas that may infect prairie dogs or ferrets with sylvatic plague. The treatment of prairie dog towns with deltamethrin (trade name Delta Dust) prior to release of ferrets is now a standard operating procedure in Colorado to ensure survival of released ferrets and their food supply. Wildlife Services treated 5,884 acres in 2015 at 5 sites to ensure the survival of released ferrets.

WS continues to use methods that could pose a hazard to ferrets and conducts programs that could be beneficial for them. The methods that may affect the black-footed ferret are foothold traps without pan-tension devices used for smaller predators, cage traps, and prairie dog fumigants and toxicants. WS believes that PDM, including the use of traps and fumigants, will have no effect on the black-footed ferret in urban, cultivated, or right-of-way areas. Moreover, the use of Safe Harbor Agreements by the USFWS with landowners to allow the restoration of black-footed ferrets allows landowners to manage and use their lands as the landowner desires, except for no toxicants or fumigants for prairie dogs is allowed in designated conservation zones. Safe Harbor Agreements are usually in effect for 10 years. If the landowner needs to manage prairie dogs within the Safe Harbor then the use of zinc phosphide treated baits and shooting are allowed within designated management zones. No anti-coagulant rodenticides can be used within the designated conservation or management zones. If WS Colorado was requested to conduct prairie dog damage management we could check the site for listed threatened and endangered species by consulting the USFWS in Colorado or their website: https://ecos.fws.gov/ipac/.

USFWS has “block-cleared” eastern Colorado, and all black-tailed prairie dog (Cynomys ludovicianus) habitats in Colorado, from the requirement to conduct ferret surveys because it is believed that no other wild ferret populations exist in this area. Likewise, ferrets were re-introduced to Moffat and Rio Blanco Counties in 2001 because no ferrets were known to occur there.

Thus, the RPAs would be for western Colorado, or all Gunnison’s (C. gunnisoni) and white-tailed (C. leucurus) prairie dog habitats. WS believes that a new BO is appropriate at this time for western Colorado outside the block-cleared zone, especially because the USFWS surveyed for ferrets in the NW Colorado NEP zone and found none.

WS Colorado has implemented all reasonable and prudent measures (RPMs) identified in previous consultations. Additionally, other measures have been implemented to reduce the risk of harm to ferrets. We conducted an analysis of ferret reintroduction sites and locations where WS Colorado conducts PDM where foothold traps would be used to catch wild canids and bobcats. We have conducted no PDM activities where ferrets have been reintroduced in the last 5 years. We did conduct predator damage management around the Wolf Creek NEP zone to enhance the survival of ferrets with no harm to ferrets. There is a low likelihood of WS Colorado conducting PDM to protect livestock, primarily calves, from coyote or lion predation in ferret reintroduction areas of southeastern Colorado over the next 5 years.

WS requests USFWS to update the 1992 BO for the black-footed ferret.

MAY AFFECT SPECIES, NOT LIKELY TO ADVERSELY AFFECT SPECIES

WS has determined that PDM activities could potentially have an impact on some T&E species, but are not likely to have an adverse impact on them. The effects range from a slight potential negative impact to a positive impact (benefit) for the species. These are discussed below and include SOPs to avoid or mitigate impacts where necessary. In addition, some T&E species could potentially be affected by one or more PDM tools, but WS PDM currently has no effect on these species because PDM is not conducted in their range, or WS in Colorado does not use the PDM methods that could potentially impact them. Whereas WS currently has no effect on these species, the potential exists, and they are included here.

Preble’s Meadow Jumping Mouse: *Threatened (63 FR 26517, May 13, 1998), exemptions for incidental take 66 FR 45829, Aug. 30, 2001)*

This Federally listed threatened species lives in densely vegetated, shrub-dominated, riparian habitats along the Front Range of Colorado from Colorado Springs north into Wyoming. Their diet is mostly grass seeds and occasional insects. Jumping mice are the smallest true hibernators and hibernate longer than any mammal. In late summer they store fat for fuel before retiring for the long winter (September to May) to a burrow in a well-drained site above the spring flood-line and below the winter frost-line.

PDM methods that have the potential to impact this species are habitat management, the use of rodenticides and other methods to reduce rodent density in their habitat, and potentially the removal of beaver dams in ARDM. WS will not conduct habitat management in their range without consulting further with USFWS. If WS recommends habitat management to reduce wildlife damage such as at an airport to a landowner/manager, WS will recommend that the landowner/manager consult with USFWS prior to undertaking such actions. Thus, habitat management will not have an effect on the mouse.

PDM intended to reduce rodent density, such as the use of toxicants, could have a negative impact on this species. These activities are almost exclusively used on lands already developed for agricultural, industrial, or residential use, and are highly unlikely to occur in the riparian areas associated with the Preble’s meadow jumping mouse. To eliminate possible impacts, WS will not use or recommend toxicants within the range and habitat of this species. The use of foothold traps during predator damage management activities will not impact the mouse because its weight is insufficient to trigger even a small predator trap.

WS ARDM methods, with the exception of beaver dam removal, will have no effect on this species, mostly as a result of their size. Beaver dam removal is generally conducted because an area becomes flooded that previously was not and is done soon after the beaver dam is built, but prior to the area becoming an established wetland. Many beaver dam removals are in irrigation ditches and structures which were specifically exempted by rule (66 FR 45829, Aug. 30, 2001). The removal of dams in these areas was seen to have a positive benefit for the mouse. Flooding from a newly established beaver dam could jeopardize jumping mouse habitat by inundating it with water and flooding their hibernation dens. If a beaver dam were in place for several years, jumping mouse habitat could form along with a true wetland as the flooded vegetation above the previous high water mark is replaced with vegetation above the new high water mark. Beaver dams, in time, can establish new wetlands that meet 3 requirements, per federal definition (40 CFR 232.2), including hydric soils, wetland hydrology, and hydrophytic vegetation. For the jumping mouse, hydrophytic vegetation and associated vegetation above the high water mark are the most important. If a beaver dam had been in place for several years, vegetation in the general area, especially along the Front Range, could benefit and develop into dense stands providing habitat for this species. However, these beaver ponds could not be removed without the appropriate permits or exemption per Section 404 of the Clean Water Act. It is WS' conclusion that the indiscriminate removal of beaver dams from streams with associated dense vegetation above the high water mark occupied by this mouse species could adversely affect the mouse's long-term survival. Because ARDM, and in particular beaver dam removal, typically does not eliminate wetland habitat, this species would not be impacted. If WS is requested to remove a beaver dam along the Front Range in the range of the Preble's meadow jumping mouse that has dense vegetation associated with it, a site-specific consultation with USFWS will be requested and the landowners will be required to request the necessary Section 404 permit should it be required. These minimizing measures will ensure that WS does not have an effect on the Preble's meadow jumping mouse.

Finally, it should be noted that if a feral swine population developed along the Front Range in habitat occupied by the jumping mouse, their removal would be beneficial. WS has not conducted feral swine damage management in this area, but could at some time in the future with the expansion of swine populations throughout the United States.

WS believes that habitat management, rodent control, ARDM and feral swine damage management activities conducted by WS will have no to minimal negative or a beneficial effect on the Preble's meadow jumping mouse. WS concludes that PDM will have ***no effect*** on this species because WS will not use PDM methods that could impact the mouse in its range. The removal of beaver dams in irrigation structures and ditches and potential feral swine damage management in the future could be wholly beneficial for the species. With these provisions in place, WS in Colorado concludes it ***may affect, but is not likely to adversely affect this species.***

USFWS Concurrence Requested

Piping Plover: *Threatened Northern Great Plains/Atlantic Coast, Endangered Great Lakes Watershed on June 29, 2010 (50 FR 50726, Jan. 1986)*

The piping plover is a small, sand-colored, sparrow-sized shorebird that nests and feeds along sandy and gravel beaches, riverbed sandbars, and sometimes sandy wet pastures. An important aspect of this habitat is that of sparse vegetation. The plover depends on its coloration for camouflage and protection. The South Platte and Arkansas River drainages in eastern Colorado are the best places to find this species where it is a rare local breeder. Recreational and off-road activities during the breeding season can be disruptive to this species. PDM methods used to haze birds, primarily from airfields, have the potential for having an effect on this species, but are not likely to adversely affect them. Methods include harassment with various sound-scare devices. WS frequently conducts hazing with sound-scare devices at airfields in eastern Colorado including some in Denver, Adams and El Paso Counties where piping plovers have been documented. Thus, WS has the potential to inadvertently scare a plover from an airfield, but field personnel may not know they are present. The most likely time to see this species would be during spring and fall migration at airfields in these Counties. WS believes that whereas this may be considered take under ESA, it would actually be beneficial because birds scared away from the air operating area are not as likely to be struck and killed by aircraft. Therefore, WS concludes that the use of sound-scare devices ***may affect, but would not likely adversely affect*** the piping plover. If a piping plover is seen at an airfield and becomes a persistent threat, WS would obtain the appropriate permit to target the bird with harassment devices to scare them away from the airfield and keep them away. It should be noted that no piping plover has been documented to be struck at an airport in Colorado from January 1990 to September 2010, but an unidentified plover has been. On the other hand, WS has PDM programs to protect nesting plovers, especially from avian predators (gulls (Laridae) mainly) and mammalian predators such as raccoons (*Procyon lotor*). If such an activity were requested, WS would consult further with USFWS.

USFWS Concurrence Requested

Mountain Plover: *Proposed threatened, reinstated on June 29, 2010 (75 FR 37353 June 29, 2010)*

This species is associated with dry upland prairies and plains where it feeds on insects and other invertebrates. Colorado is the primary breeding ground for the mountain plover; more than half of the world's population nests in the state. Despite their name, mountain plovers do not breed in the mountains, but the shortgrass prairies. Mountain plovers inhabit prairie grasslands, arid plains, and fields. Nesting plovers choose shortgrass prairies grazed by prairie dogs, bison and cattle, and overgrazed tallgrass and fallow fields. However, from year to year they do not necessarily nest at the same location. Plovers arrive at their Colorado breeding grounds in March. Trend information for the Central Breeding Bird Survey (BBS) area shows a decline of -1.71%/year from 1966 to 2012, but a smaller decline for the Colorado BBS area from 2002 to 2012 (Sauer et al. 2014). Whereas populations have declined in many traditional breeding areas, additional inventories conducted since 1995 suggest that mountain plovers are more widely distributed than previously known.

Threats include conversion of native prairie grasslands to cultivation, and possibly loss of prairie dog colonies, predation from expanding swift fox (*Vulpes velox*) populations, oil and gas exploration, and increased recreational use of public lands. This species has been seen in most counties of Colorado, but are mostly found in eastern Colorado. Prairie dog towns and livestock grazed habitat are often used by this species (Sager 1996) and PDM activities involving prairie dogs could be a concern. WS conducts prairie dog control mostly in urban, cultivated, and other developed areas where the plover is less likely to occur, though some work has been conducted on prairie dog towns in areas that they inhabit. However, work was conducted following the breeding season, primarily in fall and winter when mountain plovers were not present. WS anticipates that prairie dog damage management will have no effect on this species. The only other PDM activity that has the potential to impact this species negatively would be harassment with sound-scare devices such as pyrotechnics. This would primarily be at an airport where grass in the air operating area is normally kept short. However, this would likely be a beneficial impact on the species if it were used because it would reduce the likelihood of them being struck and killed by aircraft (1 unidentified plover was struck at an airport in Pueblo County). Because this plover’s diet is primarily insects, PDM toxicants used by WS in Colorado for rodent control will have no effect on this species. PDM is often cited as a concern for many species, but WS uses pan-tension devices on traps which precludes capture of this and other species. No other method employed by WS in PDM would have the potential for impact on this species. PDM activities focused on the removal of coyotes, skunks, and possibly swift fox within the breeding range of this species could be beneficial because these predators could impact nesting success. WS concludes that the current program in Colorado ***may affect but would not likely adversely affect*** the mountain plover, but WS believes that it will likely have no effect on the species.

USFWS Concurrence Requested

Least Tern (Interior Population): *Endangered (35 FR 8495, June 2, 1970)*

This small endangered tern species is known primarily from eastern Colorado, but has been seen in many counties throughout the state, primarily during migration. It has been known to breed in southeast Colorado along the Arkansas River drainage of Otero, Bent, and Prowers Counties. It nests on sandbars and feeds on small fish, insects, and crustaceans. The 1992 BO found that this tern's aquatic feeding habits precluded it from exposure to PDM, and that impacts from PDM activities for foxes, skunks, and raccoons would be beneficial. A few PDM methods do have the potential for having an effect on this species, but are not likely to adversely affect them. Methods include harassment with various sound-scare devices and exclusion methods such as overhead wire grids or netting. These methods are usually used to protect aquaculture facilities and airports, but have only a small potential for affecting this species. WS in Colorado frequently conducts hazing with sound-scare devices at airfields including some in Denver and El Paso Counties, but has not conducted these other activities. Thus, WS has the potential to inadvertently scare a tern from an airfield, but field personnel may not know they are present. WS believes that whereas this may be considered take under ESA, it would actually be beneficial because birds scared away from the air operating area are not as likely to be struck and killed by aircraft. On the other hand, if a nesting colony was being unsuccessful due to predation, WS could conduct PDM for their benefit. Mammalian and avian predators such as raccoons and gulls could have an impact on them. If WS were to conduct PDM for their benefit where predation was a limiting factor, WS would consult further with USFWS prior to undertaking such an activity. CPW or USFWS would likely be the agency requesting such an action. Therefore, WS concludes that the use of sound-scare devices ***may affect, but would not likely adversely affect*** the tern. It should be noted that if a tern became a persistent threat at an airfield, WS would obtain the appropriate ESA permit to target the bird with harassment devices to scare them away from the airfield and keep them away. No least terns, though, were documented to be struck at airports from January 1990 to September 2010 (FAA 2011) illustrating the minimal potential for such an occurrence.

USFWS Concurrence Requested

Southwestern Willow Flycatcher: Endangered (60 FR 10694, February 27, 1995) with critical habitat (50 CFR 60886, October 19, 2005)

This flycatcher occurs in riparian habitats with dense vegetation such as willows (*Salix spp.*), tamarisk (*Tamarix spp.*), or Russian olives (*Elaeagnus angustifolia*). It is found in southwestern Colorado from spring through summer. This species is highly insectivorous, taking insects on the wing or gleaning them from vegetation. Several reasons have been cited for their decline including habitat degradation, water changes, fire, invasive plant encroachment, nest parasitism by cowbirds, and predation (especially nestling/egg predation by great-tailed grackles and possibly corvids).

WS PDM methods that have the potential for affecting the flycatcher are either related to ARDM, bird damage management, or feral swine damage management. Beaver damage management projects involving the removal of established beaver dams have the potential for impacting this species. However, WS in Colorado removes only recently built dams, and their removal would likely be more of a benefit to this species. Recent beaver activity does have the potential to impact this species by cutting down the flycatchers' nesting trees and, thus, beaver damage management could benefit the species. The presence of WS personnel near nesting sites during ARDM or feral swine damage management has been discussed as a potential impact. However, WS personnel usually do not remain in any area for long periods and move on shortly after conducting management activities. WS believes that such encounters will have no or minimal effect on this species. Additionally, in extreme southwestern Colorado where the flycatcher nests, WS will not conduct beaver dam removal except by hand from April through July. WS removes few beaver in the range of the flycatcher.

Bird damage management activities that have only a theoretical potential for effect are mostly associated with harassment programs such as those at airports and agricultural fields. WS in Colorado has only conducted hazing operations in response to wildlife hazards on airports, and not in southwestern Colorado. However, this is only a theoretical risk and would not likely have any impact because these are used in habitats not associated with flycatcher habitat.

A limiting factor for the flycatcher was reported by Harris (1991) to be cowbird parasitism. Bird damage management methods and projects that target cowbirds, especially lethal methods, could have a positive effect on this species by reducing parasitism rates. In addition, any effort to reduce grackle or other potential nest predator in the range of the flycatcher could have a positive impact by reducing nest and nestling predation.

Considering the flycatcher's habitat preference (riparian area with dense growth), seasonal presence (summer vs. winter when most PDM methods are used), and diet (insectivorous), it is very unlikely that this species would be affected by any PDM method in Colorado. WS conducts activities such as blackbird damage management at feedlots where species such as grackles and cowbirds could be taken which could have a positive effect on the flycatcher. Therefore, WS in Colorado believes that PDM ***may affect, but is not likely to adversely affect*** this species.

USFWS Concurrence Requested

Gunnison Sage Grouse: threatened status for species (79 FR 69192; November 20, 2014), and designation of critical habitat (79 FR 69312; November 20, 2014).

Gunnison sage grouse occur on sage brush habitats and rangelands with a sage brush component in central Colorado in and near the Gunnison Basin. The species has declined in abundance due to substantial changes in habitat from human disturbance and small population size (Gunnison Sage Grouse Rangewide Steering Committee 2005). These population declines are exacerbated by the interaction of predation with habitat loss and small population size (Gunnison Sage Grouse Rangewide Steering Committee 2005). Changes in habitat affect the distribution of Gunnison sage grouse on the landscape. Some habitat changes have resulted in increases in wildlife species that depredate Gunnison sage grouse resulting in negative population effects.

The decline of Gunnison sage grouse is due to poor or no productivity (Davis et al. 2015), especially among the 7 small satellite populations (Davis et al. 2015, Oyler-McCance et al. 2005). Taylor et al. (2012) found female survival and chick survival were the most important vital rates for greater sage grouse population growth, which is similar to little to no population growth afflicting Gunnison sage grouse populations. The poor productivity and survival of chicks is likely attributed to declining habitat quality and introduction of anthropogenic habitat alterations harmful to sage grouse survival. Many studies report habitat characteristics that have changed to the detriment of Gunnison and greater sage grouse (Hovick et al. 2014, Aldridge et al. 2012, Hess and Beck 2012). Whereas habitat loss or change may be the proximate cause of sage grouse decline, these changes introduce ultimate factors, such as predation, that cause population loss (Gregg and Crawford 2007).

Raven and corvid populations have increased significantly over the last 40 years as man has introduced anthropogenic structures into sagebrush habitat (Coates et al. 2016, Coates and Delehanty 2010, Manzer and Hannon 2005). Ravens are one of the predators depredating sage grouse and in some locations are impacting population growth and survivability of nests and eggs (Coates and Delehanty 2010,). These population losses normally would not occur in pristine sage brush habitat. WS Colorado has conducted limited raven damage management to protect Gunnison sage grouse at one satellite population.

Most PDM projects have little potential to impact T&E species in Colorado because they are conducted in areas where T&E species, except Gunnison sage grouse, are known to rarely be present. Many different methods and strategies are used to abate predation to livestock and wildlife species of management concern. However, two routine methods may disturb Gunnison sage grouse. Aerial predator damage management and calling and shooting coyotes with or without decoy dogs may disturb Gunnison sage grouse on leks during late winter and early spring. WS Colorado conducts aerial predator damage management on the Cerro Mesa, Sapinero Mesa (Gunnison Basin) and Crawford 0-2 times per year for 15-30 minutes per location to remove coyotes that may depredate sheep. Eleven aerial predator damage management flights were conducted over the 5 years with only 2 flights occurring after March 15. Gunnison sage grouse were observed on leks during aerial operations over the years with about half the grouse staying on the lek and the other half dispersing into the sagebrush. Calling and shooting coyotes with or without the aid of decoy dogs has resulted in the dog or WS employee walking by or running by sage grouse with grouse displaying various behaviors from observation, hiding and walking away from the dog or WS employee. These interactions are infrequent and do not happen in all years. In summary, the disturbances are infrequent and of short duration, resulting in no harm to the Gunnison sage grouse. The removal of coyotes to protect sheep has collateral benefits to Gunnison sage grouse by removing a potential predator, especially since the sage grouse populations are low to very low on some sites where individual grouse are important to population recovery. WS in Colorado believes that PDM ***may affect, but is not likely to adversely affect*** this species.

USFWS Concurrence Requested

MAY AFFECT SPECIES COVERED BY AN EXISTING BO

WS has determined that PDM activities could potentially have an impact on some T&E species that are already covered under an existing USFWS BO. WS believes that the current BO is effective and would want to evaluate the potential impact on this species for predator damage management activities because lynx have expanded their range and abundance in Colorado.

Canada Lynx: Contiguous U.S. population threatened (65 FR 16052; March 24, 2000), *critical habitat designated, revised* (74 FR 8615, Feb. 25, 2009))

The Canada lynx, a medium sized member of the cat family, is adapted to living in areas with deep snows. Its historic range in the United States included the high country of Colorado where its main prey, the snowshoe hare (Lepus americanus), is found. A resident population of lynx in the southern Rocky Mountain region of Colorado was considered extirpated and, therefore, CPW undertook reintroduction efforts from 1999 (prior to their listing) to 2006. CPW released 218 adult lynx during this time. As a result of their listing in 2000, WS consulted with USFWS, and was issued a BO on August 25, 2005 (ES/GJ6-CO-05-F-002). The incidental take statement from that BO ended December 31, 2008. Thus, WS consulted further and another BO was issued by USFWS (ES/GJ-6-CO-09-F-007) on Dec. 7, 2009. CPW conducted a predictive analysis of habitat used by lynx in Colorado and found lynx strongly associated with spruce-fir forests at high elevations with deep snow during winter months (Ivan et al. 2011). The best winter habitat for lynx in Colorado was predicted to be the San Juan, Culebra, and Wet Mountain ranges in southern Colorado, Sawatch and West Elk mountain ranges along the Grand Mesa, and Park Range and Flat Tops in northern Colorado (Ivan et al. 2011). Summer habitat was similar to winter habitat with some stronger associations including the use of lodgepole pine and aspen habitat in the Sawatch Range of central Colorado and the use of the Medicine Bow and Front Range of northern part of Colorado (Ivan et al. 2011). We believe that PDM implemented by WS continues to be the same as that identified in the 2009 BO. It is expected that the determination that WS **may affect, but is not likely to jeopardize** the continued existence of this species is still valid. We believe that the lynx BO needs to be updated due to increases in lynx range and abundance. WS will continue to abide by the RPMs and T/Cs as given in 2009 BO until a new BO is provided.

USFWS Biological Opinion Update Requested

NO EFFECT SPECIES BECAUSE WS PDM SOPs PRECLUDE TAKE

WS has determined that PDM activities could potentially have an impact on some T&E species, but will not, as conducted under current policies. Thus, following WS PDM SOPs, WS believes that it will have no effect on these species.

Whooping Crane: *Endangered (32 FR 4001, March 11, 1967) critical habitat (43 FR 20938: May 15, 1978 and 43 FR 36588, Aug. 17, 1978)*

This species, the tallest bird in North America, breeds in northern Canada at Wood Buffalo National Park and winters in Texas, mostly at Aransas National Wildlife Refuge. In Colorado, they are only rarely found during migration in October-November and March-April. They most always migrate through the

Central Plains States east of Colorado. Cranes from this population have only been seen in eastern Colorado a few times over the last forty years. However, an experimental population from Grays Lake Idaho, where whooping cranes were fostered with sandhill cranes, did migrate through Colorado. This population was unsuccessful, because the two species hybridized. The last whooping crane from that flock died in 2002 and they are no longer seen in Colorado. Whooping cranes associate with large open wetlands, croplands, and pastures, both natural and man-influenced. They are omnivorous and feed on insects, crayfish, frogs, fish, clams, acorns, berries, and cultivated crops (e.g., barley, corn, milo, and wheat) in open fields following harvest. USFWS and WS consulted on the whooping crane in the 1992 BO. The primary methods that were considered to have the potential to adversely impact whooping cranes were the use of avicides and rodenticides. USFWS did not believe that the use of traps or hazing would have an effect on the crane. WS does not use or recommend toxicants where whooping cranes are known or believed to be present and would discontinue the use of traps, snares, and bird hazing where they were present. If they were found at an airport, WS would discuss hazing the birds away from the air operating area with USFWS. This activity would be beneficial for the crane because it would minimize the potential for cranes to be struck by aircraft, but would have to be conducted under a Section 10 permit. USFWS provided an Incidental Take Statement in the 1992 BO, but stated that no incidental take by WS, following WS SOPs, was anticipated. WS in Colorado has abided by the SOPs discussed in the 1992 BO, and has never had any known effect on whooping cranes, including those that migrated through central Colorado to Bosque del Apache National Wildlife Refuge in New Mexico. The USFWS 1992 BO concluded that no aspect of the WS program under current policy would adversely affect this species. WS believes this to still be true and does not anticipate taking any cranes, especially considering that they are only accidentally found in Colorado. Thus, WS believes it will have ***no effect*** on whooping cranes in Colorado**.**

USFWS Concurrence Requested

Greenback Cutthroat Trout: *Threatened (43 FR 16343, April 16, 1978) without critical habitat*

The greenback cutthroat trout occurred in much of the Front Range foothills and mountain lakes and streams in the Arkansas and South Platte River systems. Unfortunately, their populations were drastically reduced and they now occupy a small percentage of their original range, in 10 counties from central Colorado to Wyoming in the Platte and Arkansas River systems. This species tends to prefer cold, clear gravelly streams or mountain lakes with an abundance of invertebrates such as freshwater shrimp and insects. WS PDM has little potential to impact this threatened fish species.

This species will inhabit smaller streams and ponds, and other wetlands and have the potential to be impacted by a few aspects of WS PDM. In areas inhabited by beaver, beaver dams can be built. Beaver ponds can be beneficial or detrimental to the T&E fish species depending on the extent of beaver activity, the historic and present stream characteristics, and available spawning grounds (gravel bottoms for greenback cutthroats). Beaver ponds can provide the fish with deep water refugia during times of low flow and droughts. However, if the streams already have naturally occurring deep pools, beaver ponds could reduce necessary spawning habitat from sedimentation and loss of water through percolation (downstream waters can be lost to percolation into the sandy soils, especially where no historic wetland had existed). Additionally, beaver dams are known to alter competitive relationships among fish species, and could help non-native fish species out-compete native species (Collen and Gibson 2001). Beaver dam building activity in some areas of the state may be a long-term management goal of CPW or other management entity, but WS works closely with these entities to determine where beaver activity is wanted. It is anticipated that WS will only remove dams from developed areas such as irrigation canals and urban areas where flooding is causing problems and the greenback cutthroat is unlikely to occur. The removal of beaver dams, primarily with the use of heavy equipment or explosives, could impact the trout from the quick release of water and sediment from the bottom of a pond. However, the 58 reservoirs where this species is found are typically not associated with areas where WS would conduct beaver dam removal. In this species' range, WS will remove beaver dams by hand or slow breaching. The slow breaching of a dam would not cause excessive flooding or heavy sediment loads to go down stream and would have no effect on any fish. Additionally, WS does not remove dams that have created wetlands. Wetlands are created after an area is flooded for many years, typically more than 5 years where wetlands did not previously exist. Recent beaver activity merely alters the flow of water, typically flooding areas above the high water mark and usually has retained little sediment. Beaver dams alter the substrate from increased sediment which reduces habitat for fish requiring rocky riffles, which is a needed by the greenback cutthroat. Many WS States, especially those in the Southeast have conducted beaver damage management for the benefit of T&E species of fish and invertebrates (rocky, riffle habitat has decreased dramatically in many states because of the beaver activity). WS Colorado has not specifically conducted beaver damage management of this scale to protect the trout, but it could be done in particular areas. If WS needs to use explosives in this fish's range, WS will consult further with USFWS.

Declines in the greenback cutthroat trout population have been linked to the introduction of nonnative fishes, particularly competition and hybridization with the rainbow trout (*Oncorhynchus mykiss*). Many T&E species of fish have declined precipitously due to the introduction of nonnative species of mammals, amphibians, fish and invertebrates (e.g., crayfish) or artificially subsidized populations of native species far beyond historic population levels. Nonnative species and artificially high populations can compete for the same food supply and habitat or predate or hybridize with the native T&E species resulting in their decline. Thus, the removal of nonnative species can benefit some native T&E species. However, WS Colorado has not conducted such activities for the cutthroat. Any of these activities would only be conducted after further coordination and consultation with USFWS.

Feral swine can damage all types of wetlands, especially smaller systems. WS Colorado has conducted some feral swine damage management which undoubtedly, though inadvertently, could have benefitted native fish species, but none of the feral swine removal occurred in the range of the cutthroat. WS could conduct such activity within the cutthroat's range, which could help the cutthroat.

Any of these activities conducted by WS could have the potential for minimal negative to positive effects. WS concludes that current PDM in Colorado, though, will have ***no effect*** on greenback cutthroat trout because WS will consult further with USFWS should WS need to use explosives to remove a beaver dam in the range of the trout.

USFWS Concurrence Requested

NO EFFECT DETERMINATIONS

Mexican Spotted Owl: *Threatened (58 FR 14248, March 16, 1993) with critical habitat (69 FR 53182, August 31, 2004)*

The spotted owl lives in mixed-conifer old-growth forests in mountainous areas and heavily forested canyons along the southern Front Range and in southwestern Colorado where they feed on small rodents. The logging of old-growth forests and forest fragmentation are considered primary factors in their decline (58 FR 14248, March 16, 1993). PDM methods used by WS are not likely to impact this species because they are not typically used in the densely forested habitats inhabited by the owl. Most all WS PDM is conducted in developed areas or along "edge" habitat where animals are likely to travel. WS PDM activities rarely take place in densely forested tracts of land because wildlife typically do not cause damage in this habitat. Of all methods used by WS, the only PDM methods that have the potential to take Mexican spotted owls are rodenticides and foothold traps. WS has not used rodenticides in spotted owl habitat and does not anticipate using them in such areas. The concern would be high particularly with anticoagulants because of their potential secondary poisoning risk. The risk of take with foothold traps is nullified by using pan-tension devices and not setting traps in spotted owl habitat (typically these areas are not conducive for taking target wildlife). Therefore, WS concludes that PDM will have ***no effect*** on this species.

USFWS Concurrence Requested

New Mexico meadow jumping mouse: Endangered (79 FR33119, June 10, 2014).

The New Mexico meadow jumping mouse is endemic to New Mexico, Arizona and a small area of southern Colorado (USFWS 2016). The jumping mouse is a habitat specialist that nests in dry soils but uses moist, streamside, dense riparian/wetland vegetation. The habitat used by the jumping mouse is persistent emergent herbaceious wetlands comprised of sedge and reed canarygrass or perennial streams comprised of alders and willows. The jumping mouse accumulates fat reserves by consuming seeds for a nine month hibernation. The jumping mouse is currently at risk due to small populations, low viability and loss of large habitat patches along wetland habitats (USFWS 2014). PDM activities rarely occur within the current range of the jumping mouse in Colorado and outside of wetland habitats comprised of willow, alder or sedges that are used by the jumping mouse. Therefore, WS concludes that PDM will have ***no effect*** on this species.

USFWS Concurrence Requested

Colorado Pikeminnow: *Endangered (32 FR 4001, March 11, 1967) with critical habitat (59 FR 13374, March 21, 1994)*

The largest minnow in North America, the pikeminnow, formerly known as Colorado squawfish, can attain a length of 6 feet and weigh 80 pounds. It is dusky-green in color with a long head and large mouth. It prefers turbid rivers with turbulence and seasonal flows. Historically, the pikeminnow occurred in great numbers throughout the Colorado River system from Green River in Wyoming to the Gulf of California in Mexico. In Colorado, they are currently found in the Green, Yampa, White, Colorado, Gunnison, San Juan, and Dolores Rivers. The fish occurs in the warm, swift waters of the big rivers of the Colorado Basin. Adults are migratory, inhabiting pools and eddies just outside the main current. Young can be found in backwater areas. Dam construction and other water diversion projects along the Colorado River system contributed to its decline. The introduction of non-native bait minnows and stocking of predatory game fish species are suspected to have contributed to their decline as well. Recovery actions are underway to remove non-native fish, construct bypasses around in-stream barriers, and restock pikeminnow into native habitat. WS has determined that the current WS PDM program will have ***no effect*** on this species primarily as a result of its habitat preference.

USFWS Concurrence Requested

Humpback Chub: *Endangered (32 FR 4001, March 11, 1967) with critical habitat (59 FR 13374, March 21, 1994)*

This large minnow which can attain lengths of 20 inches has a distinctive hump between the head and dorsal fin. Preferred habitats include areas with fast currents, deep pools, and boulder habitat. Historically, this species occurred in the middle Colorado River Basin. In Colorado this species occurs in the Colorado, Green, Gunnison, and Yampa Rivers. The greatest numbers of humpbacks in Colorado are taken at the Black Rocks area of the Colorado River downstream of Grand Junction. This species is imperiled by habitat loss and degradation through dam construction and operation, but appears to be rebounding in several areas of Colorado. Competition with and depredation by invasive species, and hybridization with other closely related species are possible problems for this species, but habitat selection makes it less vulnerable to these problems than other species. Thus, it is likely that a reduction of these species is not as likely to have a beneficial effect on this species. Thus, no aspect of PDM is likely to be detrimental or beneficial to this species. Therefore, WS has determined that the current WS PDM program will have ***no effect*** on this species.

USFWS Concurrence Requested

Bonytail Chub: *Endangered (45 FR 27710, April 23, 1980) with critical habitat (59 FR 13374, March 21, 1994)*

This large minnow was found in slow water habitats of main stem rivers in the Colorado River Basin. Found historically throughout the Colorado River Drainage, in recent years bonytail chub are mostly found in the Green River of Utah and Havasu and Mohave Lakes. Bonytails were historically found in Colorado, but none were collected until 1984 at the Black Rock area of the Colorado River just west of Grand Junction. This species is threatened by stream flow regulation, habitat loss and degradation, hybridization with similar species and competition with/predation by invasive fishes, and pesticides and pollutants. The only PDM activity that has any potential to affect this species is the removal of invasive species for its protection, but WS would consult further with USFWS if WS undertook invasive aquatic species removal. Thus, WS has determined that the current WS PDM program will have ***no effect*** on this species.

USFWS Concurrence Requested

Razorback Sucker: *Endangered (56 FR 54957, October 23, 1991) with critical habitat (59 FR 13379, March 21, 1994)*

The critical habitat for the endangered razorback sucker (*Xyrauchen texanus*) includes rivers in Colorado, Utah, portions of the Colorado River in Arizona, California, and Nevada, and portions of the Gila, Salt, and Verde rivers in Arizona. The Razorback Sucker Recovery Plan was updated and supplemented by the Razorback Sucker Recovery Goals (USFWS 2002b). Found historically throughout the Colorado River Drainage, this fish has become very rare above the Grand Canyon. In Colorado, recent specimens have been taken only from the lower, mainstem Colorado, Gunnison, lower Yampa and Green Rivers. CPW reports that less than 70 specimens have been collected in the state since 1979 in Colorado. Predation and competition from nonnative fish species introduced into the Colorado River basin pose the greatest threat to the razorback sucker. Other significant threats to the razorback sucker include loss of riverine and backwater habitats, loss of connectivity of habitats, and changed inflows due to water development. Because this species prefers deeper waters in main stem rivers, the only PDM activity that has any potential to affect this species is the removal of invasive species for its protection, but WS would consult further with USFWS if WS undertook invasive aquatic species removal. Thus, WS has determined that the current WS PDM program will have ***no effect*** on this species.

USFWS Concurrence Requested

Uncompahgre Fritillary Butterfly: *Endangered (56 FR 28712, June 24, 1991) without critical habitat*

This small, 1 inch wing span, rusty brown with black bar butterfly is limited to a few sites in southwest Colorado. It is associated with the snow willow (*Salix reticulata*), providing it food and cover, at elevations above 13,200 feet. It is found in a few colonies in southwestern Colorado. The primary threat to this species is thought to be from overcollection; thus, some sites are not published. Other threats include adverse climatic changes, small population sizes, and trampling by people and livestock. PDM rarely ever occurs at this elevation and WS anticipates such in the future. Thus, WS has determined that PDM would have ***no effect*** on these species.

USFWS Concurrence Requested

Pawnee Montane Skipper: Threatened (52 FR 36176, Sept. 25, 1987) without critical habitat

This small, 1 inch wing span, brownish-yellow skipper subspecies is know from a very restricted range in the South Platte river drainage in a 4 county area of Colorado. It occurs on outcrops of Pikes Peak granite in ponderosa pine (*Pinus ponderosa*) woodlands down fairly steep slopes at an elevation of 6,000-7,500 ft. The areas where it is found has little understory development, but has blue grama grass (*Buteloua gracilis*), the larval food source, and prairie gayfeather (*Liatris spicata*), the primary nectar plant of adults. Construction of a dam and reservoir, roads, and housing has destroyed much of its habitat. It is anticipated that future developments, off-road vehicle activity and recreation could impact it further in the future. It is in an area where little, if any, PDM will ever be conducted. Thus, WS has determined that PDM would have ***no effect*** on these species.

USFWS Concurrence Requested

Threatened and Endangered Plant Species:

PDM, for the most part, has little chance of taking threatened and endangered plants, primarily because most are surviving in areas unlikely to be visited by WS personnel. Most T&E species of plants have specific habitat requirements that limit their distribution and make them vulnerable to stresses in the environment. Most species inhabit rangelands and wetlands in Colorado including talus slopes, high desert, alpine tundra, and scrublands. Few inhabit agricultural, urban, or grassland areas, and forests unless unique conditions exist. Wetlands are susceptible to drought, flooding including from beaver activity, and other conditions. In areas inhabited by T&E plant species, the removal of newly created beaver dams could be beneficial to T&E plants that have been flooded. WS in other states has conducted beaver control and dam removal for the protection of T&E plant species at the request of USFWS. WS in Colorado has not removed beaver dams for T&E plants, but potentially could at the request of a landowner or manager.

Many T&E species of plants have declined from off-road activities. Some WS personnel use 4-wheel ATVs or horses in remote areas to conduct PDM. Off-road activities are typically very minimal and usually confined to roads or developed trails and, therefore, will have no effect on plants.

Other T&E plants have been affected by livestock and wildlife grazing. Feral swine and wild horses can damage all types of rangelands and wetlands, especially smaller systems. WS has conducted some feral swine damage management which undoubtedly, though inadvertently, could have benefitted native T&E plant species because feral swine are very destructive.

Any of these activities conducted by WS could have the potential for minimal negative to positive effects. WS concludes that current PDM in Colorado, though, will have ***no effect*** on the following species because PDM activities that have the slight potential for a negative effect and those with the potential for beneficial effects have not been conducted by WS.

USFWS Concurrence Invited

Mancos Milk-vetch *(Endangered (50 FR 26568, June 27, 1985) without critical habitat)*: This matt-forming perennial grows in clumps (one foot or more) on sandstone rimrock ledges in pinyon pine (*Pinus edulis*)-juniper (*Juniperus spp.*) forests. The plants have persistent spiny leaf stalks. It is found in extreme southwest Colorado with most all specimens found on Tribal lands in Montezuma County in Colorado and San Juan County in New Mexico. The plants grow in small depressions in the sandstone and vegetation is sparse. The primary threat to the Mancos milk-vetch is mineral, oil, gas, and energy development and small distribution. Off-road vehicle use and livestock grazing are not a threat. WS has conducted few PDM activities in the range of this species. The habitat and location for this species preclude it from being disturbed by PDM activities. Thus, WS concludes that PDM will have ***no effect*** on this species.

Osterhout Milk-vetch *(Endangered (54 FR 29658, July 13, 1989) without critical habitat)*: This tall (3 feet) perennial with long linear, bright green stems and long leaflets grows in selenium rich soils of the high desert badlands. The soils are fragile and they grow best in open areas of grassy, big sagebrush (*Artemisia tridentata*) community. The known populations occur in a small area between Muddy and Troublesome Creeks in Grand County. A dam wiped out a significant portion of the population. Off-road vehicle use and oil and gas operations threaten remaining plants. The plant will grow in disturbed areas, areas with grazing and old roads, so it appears to tolerate some disturbance. Another threat to this species is the loss of pollinators which reside in rodent burrows nearby; plants thrive with an abundance of pollinators. Most known plants are on private lands. The Bureau of Land Management in concert with the Nature Conservancy has been trying to obtain the lands. WS conducts little PDM activities in Grand County and does not anticipate harming this plant. The habitat and location for this species preclude it from being disturbed by PDM activities. If beavers dam either creek, it is possible that more plants could be lost to flooding and beaver removal could have a beneficial effect. However, this has not been raised as a concern. WS has not and will not conduct rodent control in the occupied area. Thus, WS concludes that PDM will have ***no effect*** on this species.

Clay-loving Wild Buckwheat *(Endangered with critical habitat (49 FR 28562, July 13, 1984))*: This 4 inch high plant with woody base stems that cover 6 inches of the ground and dark green linear leaves that are woolly underneath is endemic to the rolling clay (adobe) hills and flats immediately adjacent to the communities of Delta and Montrose, Colorado. The Delta/Montrose area is dry, receiving an average of 8 to 9 inches of precipitation a year. The soils where the buckwheat is found are described as whitish, alkaline, clay soils of the Mancos shale formation which are relatively barren of vegetation in comparison to surrounding areas. The buckwheat is generally found within swales or drainages that are moister than surrounding areas. Plant communities associated with the buckwheat are characterized by low species diversity, low productivity, and minimal canopy cover. The associated vegetation is sparse where the dominant plant species near Delta is mat saltbrush (*Atriplex corrugate*) and, at higher elevations near Montrose, black sagebrush (*Artemisia nova*). The area this species inhabits is threatened by agricultural and urban encroachment which threatens its existence. Associated with these problems is off-road vehicle use which is also a threat. Much of the population is on BLM lands which will not be threatened by development, but off-road vehicle activity in these areas can be high. The only activity that could potentially threaten this species is off-road vehicle use. However, WS personnel use established routes and trails and mostly avoid swales and drainages, which would preclude disturbance from WS PDM activities. WS employees in the area will be notified of the population in this area and told to avoid any off-road activities where the buckwheat occurs. Thus, WS concludes that PDM will have ***no effect*** on this species.

Penland Alpine Fen Mustard *(Threatened (58 FR 40539, July 28, 1993) without critical habitat)*: This small herbaceous perennial herb is found in the Mosquito Range of central Colorado at elevations between 11,900 ft to 13,300 ft. It lives in moist areas dominated by moss (fens). The fens are fed by perennial snowbeds that accumulate on the leeward side of ridges where the alpine fen mustard is found below. PDM rarely ever occurs at this elevation and WS anticipates such in the future. Therefore, WS concludes that PDM will have ***no effect*** on this species.

Colorado Butterfly Plant *(Threatened (65 FR 62302, Oct. 18, 2000) with critical habitat (70 FR 1940, Jan. 11, 2005))*: This plant is a member of the evening primrose family and is a short-lived perennial herb with one to several 2–3 ft. tall reddish, pubescent stems. The lower leaves, 2–6 inch long, are lance-shaped with smooth or wavy-toothed margins while those on the stem are smaller and reduced in number. It is found in subirrigated, alluvial soils on level or slightly sloping floodplains and drainage bottoms, and old, abandoned stream channels with a high water table. Colonies are often found in low depressions or along bends in wide, meandering stream channels. Most populations are found a short distance from the actual channel and may even occur at the base of low, alluvial ridges at the interface between riparian meadows and drier grasslands. It is found in Wyoming, Nebraska, and Colorado at an elevation of 5000-6400 ft. Currently it is found in Jefferson, Larimer and Weld Counties of Colorado, with historical populations in Boulder and Douglas Counties. Of the known populations of the Colorado butterfly plant, the vast majority occur on private lands managed primarily for agriculture and livestock. The most immediate and severe threat to this plant is urban development. Some agricultural practices that impact riparian habitats, such as mowing, haying, application of herbicides, and water management could have an effect on this species. Finally, insect herbivory was noted in the decline of some populations. PDM will have no effect on this species. Beaver damage management could be beneficial where newly created dams may flood them for more than a temporary time. However, WS has not removed dams associated with the plant. It is expected that WS PDM will have ***no effect***, and possibly a minimal beneficial effect on this species.

Pagosa Skyrocket *(Proposed Endangered (75 FR 35721, June 23, 2010))*: This herbaceous perennial phlox grows 12-24 inches tall with a basal rosette of leaves and leaves growing up the stems. Their flowers are small white corolla tubes that are covered with glandular hairs along with the stem. They are found in Mancos Shale derived soils in, at most, lightly grazed grasslands on the edge of ponderosa pine and pinyon-juniper forests at an elevation of just below or above 7,000 feet. It is known from only a few sites close to Pagosa Springs, Colorado in Archuleta County. The two known sites for this plant are threatened with destruction from urban and agricultural development (4 square miles), especially utility installations and grazing. The limited geographic distribution (known only from U.S. Route 84 near Pagosa Springs and 10 miles west along U.S. Route 160) and potential threats to habitat makes this a proposed endangered species. The potential for PDM to impact this species is minimal because it grows in such a limited area, without grazing, where PDM will likely not be conducted. Personnel on ATVs will avoid the areas. Thus, WS concludes that PDM will have ***no effect*** on this species.

Dudley Bluffs Bladderpod *(Threatened (55 FR 4152, Feb. 6, 1990) without critical habitat)*: This very small cushion plant, 0.4-1.2 inch herbaceous perennial, is a member of the mustard family and adapted to surviving in the erosive badland soils of Piceance Basin in Rio Blanco County, Colorado. This species grows on steep barren outcrops derived from calcareous sandstone and shale that are exposed in drainages from the downcutting of streams. The bladderpod grows on level areas of the outcrop. This species is vulnerable because of its limited habitat, small population sizes, and potential for oil shale mining. Most of the plants are on BLM lands which are now protected sites. WS PDM has almost no potential to affect this species because it is found on outcrops of steep slopes. WS personnel would not need to access this habitat type to conduct PDM. WS concludes it will have ***no effect*** on this species.

Knowlton's Cactus *(Endangered (44 FR 62244, Oct. 29, 1979) without critical habitat)*: Knowlton's cactus is a tiny plant that has solitary or clustered stems measuring just over 2 inches tall and 1 inch in diameter. Flowering peaks in early May, with large white blooms, and fruits ripen in June and July. Most of the rest of the year, the cactus is inconspicuous. The species occurs on rolling, gravelly hills in a pinyon-juniper-sagebrush community at about 6,200-6,300 ft. This cactus is known only from northern New Mexico on lands purchased by the Nature Conservancy, but very close to the border in La Plata County, Colorado. The primary threat to this species was collecting prior to its listing and the small distribution. Additional threats included oil and gas exploration, livestock trampling, and possible recreational activities. PDM is conducted minimally in the habitat of this species. WS concludes that PDM will have ***no effect*** on this species, especially considering no known populations exist in Colorado.

Parachute Beardtoungue *(Proposed Threatened (75 FR 35721, June 23, 2010))*: This matt-forming, perennial herb with bluish leaves and white funnel-shaped flowers grows on steep oil shale outcrops and talus slopes in the Roan Plateau of Garfield County, Colorado at an elevation of approximately 8,000 feet to 9,000 feet. It is highly adapted to unstable soil conditions and disappears where soil becomes stable. It is a proposed threatened species because it has a limited geographic distribution and a very specialized habitat. The potential for PDM to impact this species is nil because it grows in an area where PDM will not be conducted and WS ATVs will not travel. WS concludes that PDM will have ***no effect*** on this species.

Penland Beardtoungue *(Endangered (54 FR 29658, July 13, 1989) without critical habitat)*: This member of the snapdragon family at about ten inches tall grows in selenium rich, clay soils in alkaline shale formations of the high desert badlands. The soils are fragile and they grow best in open areas of grassy, big sagebrush (*Artemisia tridentata*) community. The known populations occur in a small area along Troublesome Creeks in Grand County. Off-road vehicle use and oil and gas operations threaten the small population of plants. The Bureau of Land Management in concert with the Nature Conservancy has been trying to obtain the lands which is completely within the range of the Osterhout milk-vetch. WS conducts little PDM activities in Grand County and does not anticipate harming this plant. The habitat and location for this species preclude it from being disturbed by PDM activities. If beavers dam Troublesome Creek, it is possible that plants could be lost to flooding, and beaver or dam removal could have a beneficial effect. However, this has not been raised as a concern. Thus, WS concludes that PDM will have ***no effect*** on this species.

North Park Phacelia *(Endangered (47 FR 38540, Sept. 1, 1982) without critical habitat)*: This species of phacelia, a biennial or possibly a short-lived perennial, grows in sparsely vegetated areas of the Coalmont Formation in North Park of Jackson County, Colorado. It is found only in the erosive sandstone outcrops on the sides of steep ravines or sandy hills. Only 10 populations are known with most plants occurring at 2 of the sites. The plants have many stiff hairs on branching or single, upright stems that are highly divided and topped with purple flowers from July to August. Threats include off-road vehicle disturbance, livestock grazing, and coal, oil and gas exploration and the small number of populations. PDM methods have no to minimal potential to affect this species because the habitat it is found in is not conducive for PDM. Additionally, WS conducts only sporadic operational PDM in Jackson County. Thus, WS believes it will have ***no effect*** on this species.

DeBeque Phacelia *(Proposed Threatened (47 FR 38540, Sept. 1, 1982) without critical habitat)*: This rare low-growing, herbaceous annual plant with a tap root is associated with expansive clay soils in the Wasatch Formation in Mesa and Garfield Counties. This plant occurs in small patches totaling 104 acres in appropriate soils surrounded by similar soils where it does not grow. It grows on moderately steep slopes, benches, and ridge tops, but usually confined to small areas covering a few square yards. Seeds plant themselves by falling into soil cracks that close when wetted. The plant germinates in early April, flowers between late April to June, sets fruit in mid-May to July, and disintegrates shortly thereafter leaving no trace of their existence. The plant grows in an inhospitable environment with wide temperature variations, erosive saline soils, and long drought periods. It grows at about 5,000 to 6,200 feet elevation with the entire range within the southern part of the Piceance Basin, one of the largest natural gas reserves in North America. The primary threat to this species is oil and gas exploration and development, followed by other threats including small population size, off-road vehicle disturbance, and livestock grazing. PDM methods will have no potential to affect this species. WS personnel do use ATVs and horses to conduct work in some areas, but stay mostly on established trails. Unlike the recreational use of an area for off-road ATVs, WS work is conducted relatively quickly in an area with little to no damage to the environment because repeated use of an area is minimal. Thus, WS believes it will have ***no effect*** on this species.

Dudley Bluffs Twinpod *(Threatened (55 FR 4152, Feb. 6, 1990) without critical habitat)*: This twinpod, a small herbaceous perennial, 5-7 inches, is a member of the mustard family that adapted to living in the erosive badland soils of Piceance Basin in Rio Blanco County, Colorado. It was first documented in 1982. It was named for its distinctive heart-shaped fruits that attach to stalked at the pointed end. The leaves, stems and even fruits of this species are all covered with small, specialized branched hairs that resemble a splatter caused by a rock dropped in mud. In May and June the plant produces small, yellow flowers. This species grows on steep barren outcrops derived from calcareous sandstone and shale that are exposed in drainages from the downcutting of streams. The twinpod grows on the steep sideslopes of the outcrop. This species is vulnerable because of its limited habitat, small population sizes, and potential for oil shale mining. Most of the plants are on BLM lands, which are now protected sites. WS PDM activities will have no effect on this species due to where the species is found, on outcrops of steep slopes. WS personnel would not need to access this habitat type to conduct PDM. WS concludes it will have ***no effect*** on this species.

Colorado Hookless Cactus *(Threatened (44 FR 58868, October 11, 1979) without critical habitat)*: The Colorado hookless cactus, formerly Uinta Basin hookless cactus which was separated into 3 species *(74 FR 47112, Sept. 15, 2009)*, is a barrel-shaped cactus that grows normally to 5 inches in height (some to a foot) and 4 inches in diameter. The stems have 8 to 15 ribs that extend the length of the plant with aeroles or small cushioned areas with hooked spines radiating out from them. They have pink to violet blooms and small barrel-shaped fruit. They occur primarily on alluvial benches along the Colorado and Gunnison Rivers and their tributaries. Colorado hookless cactus generally occurs on gravelly or rocky surfaces on river terrace deposits and lower mesa slopes where they are mostly associated with desert shrublands up to pinyon-juniper. They have occurred at almost 100 sites, but half have not been seen in the last 20 years. Current threats include habitat loss (almost 20% of the lands have been covered by water, developed into agricultural lands, or urbanized), oil and energy development, utility corridors (power lines), invasive plant species, off-road vehicle use, water development, illegal collection, livestock and wildlife (mainly desert cottontails (*Sylvilagus audubonii*)), grazing and trampling, parasitism by the cactus-borer beetle (*Moneilema semipunctatum*), pesticides and herbicides, hybridization with other cactus, and climate change (especially drought). PDM activities will not impact this species or its habitat because little PDM is conducted in this type of habitat. WS concludes it will have ***no effect*** on this species.

Mesa Verde Cactus *(Threatened (44 FR 62471, Oct. 30, 1979) with no critical habitat)*: This perennial, low growing, globe-shaped cactus is mostly single-stemmed with multiple stems associated with disease or herbivory. It generally grows to just over 4 inches tall and 3 inches in diameter. The population appeared very stable until 2002 when their population died back from a lack of cactus recruitment and severe mortality, believed to be a combination of severe drought and a higher-than-typical incidence of insect predation. However, they rebounded by 2005 back to pre-2002 levels. All Mesa Verde cacti are currently on Ute Mountain Tribal lands in Colorado. They are restricted to sparsely vegetated badlands of clay loam soils derived from upper Cretaceous Mancos shale in Colorado. Populations are located in a narrow strip of land between Cortez, Colorado, and Sheep Springs, New Mexico, at elevations ranging from 4,600 - 6,600 ft. These formations erode easily, forming low, rolling hills where plants are found on hilltops and benches, but less so in basins or swales. The soils are high alkaline, have poor permeability, and have shrink-swell tendencies which make harsh sites for plant growth. However, during severe hot or cold dry periods, individual plants shrink and retract back into soils which can minimize desiccation or dehydration. They are typically associated with desert shrublands and grasslands. Current threats include habitat loss by utility corridors (power lines) and highways, oil and energy development, off-road vehicle use, illegal collection, livestock grazing and trampling, and climate change (especially drought). PDM activities will not have impacts on this species or its habitat because little PDM is conducted in this type of habitat. WS concludes it will have ***no effect*** on this species.

Ute Ladies'-tresses *(Threatened (*57 FR 2048*, Jan. 17, 1992) without critical habitat)*: Ute ladies'-tresses is a perennial, terrestrial orchid with 7 to 32-inch stems arising from tuberously thickened roots. The flowering stalk consists of few to many small white or ivory flowers clustered into a spiraling spike arrangement at the top of the stem. The species is characterized by whitish, stout flowers. It blooms, generally, from late July through August. The orchid occurs along riparian edges, gravel bars, old oxbows, high flow channels, and moist to wet meadows along perennial streams. It typically occurs in stable wetland and seepy areas associated with old landscape features within historical floodplains of major rivers, as well as in wetlands and seeps near freshwater lakes or springs. Ute ladies'-tresses ranges in elevation to 7,000 ft. Nearly all occupied sites have a high water table (usually within 5 to 18 inches of the surface) augmented by seasonal flooding, snowmelt, runoff, and irrigation. Threats to the Ute ladies'-tresses include groundwater pumping, water diversions, sand and gravel mining, recreation impacts, illegal collection, and invasion of their habitat by nonnative plant species such as Johnson grass (*Sorghum halepense*) and Bermuda grass (*Cynodon dactylon*).

The only aspect of PDM that potentially could affect this species is ARDM, specifically beaver dam removal. The removal of newly established beaver dams would likely be beneficial in the short term, but this species is well adapted to flooding, so it would have minimal potential to be positive. However, if the area was to remain flooded for an extended time frame and new habitat was not available above the new high water mark, then flooding by beavers would be detrimental. If flooding of Ute ladies'-tresses occurs, WS would not conduct ARDM within habitat occupied by this species without further consultation with USFWS. WS concludes that PDM will have ***no effect*** on this species because WS does not travel through the areas where the plant grows while conducting PDM.

NONESSENTIAL EXPERIMENTAL POPULATIONS IN COLORADO

USFWS, often in coordination with CPW or other State agencies, establishes T&E species NEPs. These populations require WS to Conference with USFWS about ways to conserve these species. Under ESA, NEPs are treated as threatened when they are within a National Wildlife Refuge or National Park, and are treated as a proposed species on other lands within the NEP established zone. However, if they are outside the designated recovery zone, they are treated as endangered until USFWS captures and returns the individuals to the designated zone, or expands the recovery area to include the area they are found. ESA requires federal agencies to conference with USFWS for these species. In Colorado, one species has designated NEPs (Table 7) and 2 species have been found in Colorado outside of their NEP zones.

Table 7. Federal threatened and endangered species from Non-essential, experimental populations in Colorado.

Species	*Scientific Name*	Status	Locale	Habitat	Diet*	PDM
Black-footed Ferret	*Mustela nigripes*	NEP	BLM lands in Rio Blanco and Moffat Counties	R	S	-, 0, +
Black-footed Ferret	*Mustela nigripes*	NEP	USFWS lands in Adams Counties	R	S	-, 0, +
Black-footed Ferret	*Mustela nigripes*	NEP	Private lands in Baca, Pueblo, Prowers, Larimer and Weld Counties	R	S	-, 0, +
Gray Wolf	*Canis lupus*	NEP	ID/MT/WY	FGR	Lcs	-, 0
- Mexican Gray Wolf	*Canis lupus baylei*	NEP	AZ/NM	FGR	Lcs	-, 0
California Condor	*Gymnogyps californianus*	NEP	Grand Canyon NP: AZ	FGR	C	-, 0, +

*Diet - Capitals = large proportion of diet - Lower case = small proportion of diet. ** Not listed in Colorado

STATUS
NEP - Nonessential exp. pop.

HABITAT
F - Forests/riparian borders
G - Grassland/meadow
R - Range/sage/high desert

DIET
C- Carrion
L - Large Vertebrates
S - Small vertebrates (i.e. rodents, birds)

PDM - Impacts
(-) - Negative
0 - none
(+) - Positive

Black-footed Ferret: *Endangered (32 FR 4001; March 11, 1967), NEP population designated (61 FR 11320, March 20, 1996)*

Black-footed ferrets are endangered in Colorado and were discussed under that section above, but it is likely no wild population exists in Colorado with the last credible sighting in the 1940s. An NEP was established in northwestern Colorado near Wolf Creek in 2001. In 2010, fall surveys found a minimum population of 1 ferret. The population is thought to have been affected by an outbreak of plague in the area, and possibly other maladies. It was believed in 2015 that this population of ferrets no longer existed dues to collapse of the prairie dog population due to plague (J. Hughes, USFWS, personal communication, 7/19/16). Since 2014, CPW and the Colorado Black Foot Ferret Working Group has established procedures that prairie dog towns will be treated before and after introductions of ferrets with Delta Dust to ensure survival of prairie dogs and ferrets. Additionally, a new plague vaccine has been developed and an experimental use permit issued by USDA APHIS that would reduce the potential for plague outbreaks.

WS worked with CPW to provide protection for the black-footed ferrets from predators (coyotes, badgers, gray fox, and feral dogs) in the Wolf Creek NEP. WS used methods that would have no effect on the ferret such as aerial shooting and ground shooting in and around the prairie dogs, and padded-jaw foothold traps with pan-tension devices on the periphery away from the prairie dog colonies. WS in Colorado has not taken a ferret, but will continue to work with CPW to ensure that predator damage management and other projects have minimal potential to take a ferret. Additionally, WS will only conduct prairie dog damage management outside of Management Zones as part of a Safe Harbor Agreement for the NEP.

Should WS need to conduct damage management of a prairie dog population within the Conservation Zone of a Safe Harbor Agreement for NEP, WS will consult with USFWS prior to conducting the project.

WS believes that this conference opinion should be similar to the BO requested above. WS will abide by the BO and CPW's advice to avoid taking ferrets in the NEPs.

USFWS Concurrence Requested

Gray Wolf: *Endangered (32 FR 4001, March 11, 1967; 41 FR 17736, April 28, 1976; 43 FR 1912, March 9, 1978) without critical habitat, NEP designations for Yellowstone National Park in Wyoming, Idaho, and Montana and in Central Idaho and southwest Montana (59 FR 60252 and 60266, respectively, Nov. 22, 1994)*

Gray Wolf. The gray wolf was extirpated from much of the lower 48 continental United States by the 1930s with few remaining into the 1940s. The last known wolf in Colorado was killed in 1943. They were reintroduced into Idaho, Montana and Wyoming as outlined in the Wolf Recovery Plan under two NEPs in the 1990s. The 2 NEPs have been very successful and USFWS would like to remove them from the T&E list because they have surpassed recovery goals. The range for the experimental populations did not include Colorado, but wolves in Colorado will be, for the most part, from the Yellowstone NEP. Colorado has had several sightings of Gray Wolves in Colorado including one killed on I-70 in 2004, a collared female gray wolf from the Yellowstone NEP, an unknown male in Jackson County, Colorado in 2007 that was likely from the Yellowstone NEP, another collared female wolf from the Yellowstone NEP in Eagle County in 2009, an unknown wolf near Kremmling in early 2015, another collared male wolf from the Yellowstone NEP living in North and Middle Park since late spring 2015 and several reports of wolves in northwestern Colorado. If a wolf from the Yellowstone NEP, or the Central Idaho NEP, are in Colorado, north of I-70 (the dividing line in Colorado for wolves from the northern Rocky Mountain wolf and the Mexican wolf distinct population segments) they would be classified as an endangered species.

Many tools used in PDM, primarily those used for predators including foothold traps, snares, M-44s, and aerial predator damage management, have the potential for taking a wolf. In the event that WS personnel sight a wolf or find evidence that indicates their likely presence in the area, such as scat or tracks, WS will initiate mitigation measures recommended by the USFWS Wolf Recovery Team. Within the area where wolves or verified sign has been found and documented by WS personnel, M-44s and neck snares will not be used, and foothold traps and leg-snares will be checked daily. WS Colorado will implement further conservation measures by conducting no aerial predator damage management from September 1 to November 30 in areas where gray wolves are known to occur, converting to break-away body snares with stops that are checked daily, use thermal imagers or night vision when calling and shooting coyotes at night in areas where wolves are known to occur, and use sirens or calls that make prospective depredating coyotes howl or call back prior to calling and shooting coyotes in an area where wolves are known to occur. In addition, the USFWS Wolf Recovery Team will be notified. WS may assist the Wolf Recovery Team in trapping the wolf so that it can be examined. However, if it was determined to be a released hybrid, it would be euthanized.

In the event that a wolf has been found to kill livestock in Colorado, WS will verify and document the predation, obtain pertinent evidence such as photographs, and contact the USFWS Wolf Recovery Team. Should the Recovery Team determine that the offending individual(s) need to be removed, it would be likely that WS would be asked by the Recovery Team to conduct the PDM activities.

It is WS's finding that PDM activities may affect wolves. However, PDM methods are not likely to jeopardize wolf recovery, especially considering that wolves are intermittently found in Colorado and they would be from the Yellowstone NEP which is considered recovered. WS would initiate SOPs to avoid taking a wolf, if a wolf or its sign is found north of I-70 outside of its NEP range. Therefore, WS concludes that PDM ***may affect, but is not likely to jeopardize*** this species, but WS will abide by the results of the current consultation to ensure that WS will not jeopardize the Mexican wolf.

USFWS Concurrence Requested

Mexican Gray Wolf: *Endangered (32 FR 4001, March 11, 1967; 41 FR 17736, April 28, 1976; 43 FR 1912, March 9, 1978) without critical habitat, NEP designation in Southwest (63 FR 1763, January 12, 1998)*

The gray wolf, including the Mexican subspecies, was extirpated from much of the lower 48 continental United States in the first half of the twentieth century. The Mexican wolf population once inhabited areas in Arizona, New Mexico, Texas, and Mexico, but they were probably extirpated from the U.S. by 1970 with the last verified report of a wild wolf; and may altogether be extirpated now in Mexico. Fortunately, captive Mexican wolves were available for their recovery. In 1998, wolves were reintroduced in Arizona and New Mexico as an NEP under section 10(j) of the Endangered Species Act which is outlined in the Wolf Recovery Plan. WS is currently in consultation/conferencing with USFWS for the Mexican gray wolf. Many tools used in PDM for large predators such as foothold traps, snares, M-44s, and aerial predator damage management have the potential of taking a wolf. WS follows the conservation measures established in the 1998 BO and Conference Opinion issued by USFWS (1998a); this was actually two opinions - a BO for "naturally occurring wolves" and a "Conference Opinion" for the reintroduced NEP. WS in Colorado believes that we will only encounter wolves from the NEP. Any wolf seen in Colorado south of I-70, though, is considered endangered from the Mexican wolf NEP. WS will abide by the same measures given for the gray wolf above. The measures would minimize the potential for a wolf to be taken.

It is WS's finding that PDM activities may affect wolves. However, PDM methods are not likely to jeopardize wolf recovery, especially considering that wolves would most likely be from the NEP, and WS would initiate mitigation measures to avoid jeopardy should a wolf be found outside of its NEP range in Colorado. The 1998 BO and Conference Opinion provided adequate RPAs and RPMs to avoid take by WS. USFWS issued incidental take statements for the take of naturally occurring wolves in a BO and those from the NEP in the Conference Opinion, but did not anticipate that any would be taken with conservation measures in place. WS in Colorado will continue to abide by the 1998 BO/Conference Opinion should a Mexican gray wolf be found to wander north of the NEP. Therefore, WS concludes that PDM ***may affect, but is not likely to jeopardize*** this species, but WS will abide by the consultation to ensure that WS will not jeopardize the Mexican wolf.

USFWS Concurrence Requested

California Condor: *Endangered (32 FR 4001, March 11, 1967) with critical habitat in California (41 FR 187, September 24, 1976), NEP designated for Southwest reintroduction (61 FR 54044, October 16, 1996)*

The condor is the largest flying land bird in North America. They are classified as New World vultures, which, unlike Old World vultures, find food items by sight and not smell. They are a long-lived species that mature and reproduce slowly. At the end of the last ice-age, condors were found across North America, but the extinction of giant mammals during the late Pleistocene coincided with a reduction in the condor's range, remaining only along the Pacific coast. After the arrival of Europeans in North America, the condor population dwindled from a combination of shooting, the use of DDT, and other impacts associated with the settlement of the West. The California condor was extirpated over most of its range by the late 1970s and all wild condors were taken into captivity in 1980s. The propagation program was a success and they were reintroduced back into the wild in California. In addition, an NEP of California condors was established at Vermillion Cliffs in northern Arizona. Members of the NEP not occurring within the NWR or NPS System are treated as proposed species under Section 4 of the Endangered Species Act of 1973 for the purpose of Section 7. Consultation/conferencing is not required for proposed species unless a federal agency determines that its action is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. However, Colorado was not included in the NEP. Thus, they are treated as endangered while they are in Colorado.

Three condors wandered from the NEP to Grand Junction, Colorado in 1998, but did not stay and returned to the NEP (USFWS 1996). As a result of this, M-44s are not used in a 5 mile corridor around Colorado and San Juan Rivers from March 1 to October 1. Since this has not been a regular occurrence and occurred shortly after their release, it is expected that this will rarely occur, if ever again. However, if a California condor is seen in Colorado again, WS will implement the reasonable and prudent alternatives identified by USFWS in their 1992 BO to protect the condor. The BO provided by USFWS in 1992 as a result of that consultation evaluated the impacts of methods used in PDM on the California condor in its native range, including the use of the M-44, DRC-1339, rodenticides, foothold, body-gripping, and cage traps, snares, shooting, aerial predator damage management, and scare devices. WS made several "may affect" determinations and requested consultation for the condor. USFWS decided which "may affect" determinations were serious enough to escalate to jeopardy and which could be dismissed as "not likely to adversely affect." The only method of concern used in PDM in the 1992 BO was the M-44. RPAs were given for the use of the M-44 in the 1992 BO to avoid jeopardy to the California condor and a "not likely to result in jeopardy" opinion was given. In the 24 years since the BO was written and the RPAs were adopted by WS, PDM has not resulted in "take" of a California condor in its native range or the NEP in Arizona. The proposed action by WS Colorado would abide by the 1992 BO and implement all RPAs provided for PDM. WS will not use double foothold trap sets (more than one trap within 20 feet of each other) for coyotes or other large predators in any area where a condor has been sighted and will use only single M-44 sets, not closer than 300 feet from each other, which will be placed in a recess and capped so the head is not visible. WS will adhere to standard operating procedures for foothold traps and snares including no visible bait at the set site and that trap set sites (except traps used for mountain lions) will be no closer than 30 feet from a draw station. By following these RPAs, the proposed action is not likely to jeopardize the NEP should they occur in Colorado.

Since the 1992 BO was written, new evidence has found that many terrestrial raptors (including California condors), are impacted from lead toxicity as a result of ingesting lead shot and bullet fragments from carcasses and gut piles (Fisher et al. 2006). As a result of this finding, WS has been working towards the use of nontoxic shot (bismuth, steel, tungsten, nickel, and combinations thereof) nationally in aerial predator damage management, and nontoxic bullets for ground-based shooting. Research into the toxicity of nontoxic shot to birds is limited, but so far ingestion of nontoxic shot does not appear to adversely affect birds (Brewer et al. 2003, Ringelman et al. 1993). It has been standard WS operating procedure to retrieve carcasses shot with lead bullets and shot as allowable, thus minimizing the potential risk to raptors, which would be beneficial for condors too should they come back to Colorado.

On the other hand, PDM could have a positive effect on the California condor. Coyotes were responsible for the depredation of at least 3 condors in Arizona between 1996 and 2002 (Cade et al. 2004), and management targeting coyotes could be considered beneficial for them if it has been conducted in an area where they come into the State. Thus, PDM is likely to have a potential beneficial effect on the condor.

It is WS's conclusion that by following the RPAs in the 1992 BO, restricting the use of M-44s along the Colorado and San Juan Rivers, and by using only non-lead ammunition where they have been found in Colorado, PDM activities ***may affect, but are not likely to adversely affect*** this species.

USFWS Concurrence Requested

STANDARD OPERATING PROCEDURES

WS personnel will adhere to the following SOPs to protect listed T&E and sensitive species. Several are method specific with consideration for a wide variety of T&E species while others are specific to certain species. Included below are SOPs incorporated into PDM in general, for specific methods, and for specific species or groups of species. Additionally, WS abides by the RPAs, RPMs, or T/Cs for incidental take statements already in place for species that have been covered in a BO and for any newly issued BO.

General SOPs

X WS personnel are highly experienced and trained to select the most appropriate method(s) for taking problem animals with little impact to T&E species. When working in an area that has T&E species or the potential for T&E species to be exposed to PDM methods, WS personnel will know how to identify sign of the target and T&E species and use PDM methods accordingly.

X WS personnel work with research programs such as the WS-National Wildlife Research Center to continue to improve the selectivity of management devices.

X WS personnel using 4-wheel ATVs will use roads and existing trails as possible to conduct field work.

X WS personnel will retrieve the carcasses of animals shot with lead bullets or shot from the field as possible and dispose of them according to WS Policy.

[illegible]

Species	Scientific Name	CNHP State Rank	Where Found	Habitat	When Found	Effects of PDM
			MAMMALS			
Cliff Chipmunk	Tamias dorsalis	S2	Moffat Co.	Pinyon-juniper	All year	0
Dwarf Shrew	[illegible]	S2	[illegible]	[illegible]	All year	0
Ord's Kangaroo Rat	Dipodomys ordii [illegible]	S3	Moffat Co.	Open sandy	All year	0
Pygmy Shrew	[illegible]	S2	[illegible]	[illegible]	All year	0
Silky Pocket Mouse	Perognathus flavus [illegible]	S3	San Luis Valley	Shortgrass	All year	0
[illegible]	[illegible]	S2	Northwest	[illegible]	All year	0
Brazilian Free-tailed Bat	Tadarida brasiliensis	S1	Scattered sites	Caves, bldgs.	Summer	0
Swift Fox	[illegible]	S3	[illegible]	[illegible]	All year	0, +
			BIRDS			
American peregrine falcon	Falco peregrinus anatum	S2	Western Colo.	Variety	All year	0
Black swift	[illegible]	S3	Western Colo.	Falls	Summer	0
Bobolink	Dolichonyx oryzivorus	S3	North central	Grassland	Breed	0
Columbian sharp-tailed grouse	[illegible]	S2	Western Colo.	[illegible]	All year	0
Grace's warbler	Dendroica graciae	S3	Southwest	Pine-oak	Breed	0
Gray vireo	[illegible]	S2	Western Colo.	[illegible]	Breed	0
Greater sandhill crane	Grus canadensis tabida	S2	Northwest	Marsh grassland	Breed S	0, +
Lewis's woodpecker	[illegible]	S4	[illegible]	[illegible]	All year	0
Northern sage grouse	Centrocercus urophasianus	S4	Northwest	Sage	All year	0, +
[illegible]	[illegible]	S2	[illegible]	[illegible]	Breed	0
Prairie falcon	Falco mexicanus	S4	Statewide	Prairie	All year	0
Sage sparrow	[illegible]	S2	Western Colo.	Sage	Breed	0
White-faced ibis	Plegadis chihi	S2	Statewide	Marsh grassland	Breed	0, +
[illegible]	[illegible]	[illegible]	Statewide	Wetlands	Breed	0, +
Boreal owl	Aegolius funereus	S2	North central	Boreal forest	All year	0
[illegible]	[illegible]	[illegible]	Western Colo.	[illegible]	All year	0
Ferruginous hawk	Buteo regalis	S3	Statewide	Open Prairie	All year	0
[illegible]	[illegible]	[illegible]	Northeast	Grassland	All year	0, +
McCown's longspur	Calcarius mccownii	S3	North central	Grassland	Breed	0
Mountain plover	[illegible]	S2	Eastern Colo.	Prairie	Breed	0
Northern goshawk	Accipiter gentilis	S3	Western Colo.	Forest	All year	0
Northern pygmy owl	[illegible]	[illegible]	Western Colo.	Woodlands	All year	0
Veery	Catharus fuscescens	S3	Western Colo.	Moist woods	Breed	0
[illegible]	[illegible]	S4	[illegible]	[illegible]	All year	0, +
White-winged crossbill	Loxia leucoptera	S1	Western Colo.	Conifer forest	Winter	0
Willow flycatcher	[illegible]	[illegible]	[illegible]	[illegible]	Breed	[illegible]
Wilson's phalarope	Phalaropus tricolor	S4	Statewide	Wetland	Breed	0

CNHP = Colorado Natural Heritage Program. Effects of PDM: (-), negative; (+), positive; 0, no effect

State Rank (relative rank of endangerment in the state): S1 Critically imperiled; S2 Imperiled; S3 Rare; S4 Widespread, but long-term concern

X WS projects involving habitat management where a T&E species could be affected will be discussed with USFWS prior to implementation. If WS recommends habitat management, the cooperator will be informed that they will need to consult with USFWS and obtain the necessary permits prior to receiving assistance from WS.

X Netting placed by WS personnel will be monitored frequently for ensnared birds or other wildlife.

X Pan-tension devices will be used on foothold traps and foot snare triggers to reduce the capture of nontarget wildlife including T&E species that weigh less than the target species.

X WS personnel adhere to all label requirements for toxicants. EPA labels have a section on T&E species and environmental considerations that must be followed, and WS personnel will abide by these. These restrictions invariably preclude exposure to T&E species.

Gunnison Sage Grouse SOPs

- If fencing is recommended to exclude or deter livestock predators in Gunnison sage grouse habitat then the fencing should be marked with vinyl siding undersill on the top strand at 1-meter intervals or a white rope or similar material to mark the top strand of fence within 500 meters of a lek (Stevens et al. 2012). It is preferable that no new fencing (e.g., barb wire, net wire, woven wire) be erected in Gunnison sage grouse habitat to avoid collisions and additive mortality.

Plant SOPs

- WS personnel will not collect plants while afield.

Black-footed Ferret, Mexican Gray Wolf, and California Condor

- WS personnel will abide by all RPAs, RPMs, and T/Cs outlined in the BOs, Consultations, or Conference Opinion for these species.

SUMMARY

The analysis for each listed federal threatened and endangered species is summarized for the methods that would be used to manage predation (Table 8). The table shows the methods that would be used and WS Colorado's determination of the level of effect.

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APPENDIX D: BIOLOGICAL OPINION TO INFORMAL SECTION 7 CONSULTATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Colorado Ecological Services

IN REPLY REFER TO
FWS/R6/ES/CO

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Mail Stop 65412
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Western Slope:
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ES/CO: USDA/APHIS-Wildlife Svcs, Colorado
TAILS 06E24100-2016-I-0303

November 18, 2016

Martin Lowney
State Director, Colorado
USDA, APHIS, Wildlife Services
12345 Alameda Parkway, Suite 204
Lakewood, Colorado 80228

Dear Mr. Lowney:

On August 1, 2016, we received your biological assessment (BA) and request for section 7 consultation pursuant to the Endangered Species Act (ESA) for Wildlife Services' (WS) predator damage management (PDM) program in Colorado to protect livestock, wildlife species of management concern, and human safety. You are currently preparing an environmental assessment pursuant to the National Environmental Policy Act (42 U.S.C. 4321) to examine issues, alternatives and environmental consequences of PDM to protect these resources.

The WS Colorado Program is part of the national WS program, which has been previously reviewed under a formal consultation between WS and the U.S. Fish and Wildlife Service (Service), resulting in a biological opinion (BO) from the Service in 1992 (Service 1992). Since then, changes to WS Colorado PDM activities and new threatened and endangered species listings prompted requests for updated Section 7 consultations. Since the 1992 BO, WS in Colorado and the Service have consulted on the WS aquatic rodent damage management (ARDM) program, on potential impacts to Canada lynx (*Lynx canadensis*) from the WS PDM program (WS 2009, USFWS 2010), and on a programmatic review of the WS Colorado program in 2011 (WS 2011, USFWS 2011).

You have made a determination of no effect for the following animal species:

Whooping crane	*Grus Americana*
Mexican spotted owl	*Strix occidentalis lucida*
Western yellow-billed cuckoo	*Coccyzus americanus*
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*
Preble's meadow jumping mouse	*Zapus hudsonius preblei*
Grizzly bear	*Ursus arctos horribilis*
Colorado pikeminnow	*Ptychocheilus lucius*

Razorback sucker	*Xyrauchen texanus*
Humpback chub	*Gila cypha*
Bonytail	*Gila elegans*
Greenback cutthroat trout	*Oncorhynchus clarkii stomias*
Pallid sturgeon	*Scaphirhynchus albus*
Uncompahgre fritillary butterfly	*Boloria acronema*
Pawnee montane skipper	*Hesperia leonardus montana*

You have also made a no effect determination for all Federally listed plant species in Colorado. In addition, you have not requested consultation on any critical habitats. We acknowledge your determination of no effect for these species, but neither 7(a)(3) of the Act, nor implementing regulations under section 7(a)(2) of the Act require the Service to review or concur with this determination; therefore the Service will not address these species further. However, we do appreciate you informing us of your analysis for these species.

You have determined that the PDM program in Colorado may affect, but is not likely to adversely affect the following species:

Least tern	*Sternula antillarum*
Piping plover	*Charadrius melodus*
Southwestern willow flycatcher	*Empidonax traillii extimus*
California condor	*Gymnogyps californianus*
Gunnison sage-grouse	*Centrocercus minimus*
Mountain Plover	*Charadrius montanus*
Gray wolf	*Canis lupus*

We concur with your determination of may affect, but not likely to adversely affect for these species, with the exception of the mountain plover. The mountain plover was removed from consideration for listing in 2011 (76 FR 27756); therefore, consultation is not required. Details and rationale for the other species are provided below. Additionally, you have requested a consultation update for the Black-footed ferret (*Mustela nigripes*) and Canada lynx (*Lynx canadensis*). Discussion and updated information for these species is provided below as well.

Least tern, piping plover, southwestern willow flycatcher. These bird species are not targeted by WS for control. Their wetland and riparian habitat preferences limit the likelihood of their exposure to most WS actions. The use of sound devices by WS at airports may scare these birds from runways (if present, although unlikely), but this would be purely beneficial by guiding them out of harm's way (e.g., preventing a bird-airplane strike). WS limited control of gulls, corvids, and cowbirds could also provide a benefit for these species by removing potential nest predators and nest parasites. Additionally, beaver dam removal within the range of the Southwestern willow flycatcher would only take place by hand if done during the nesting season. The least tern and piping plover were included in the 1992 and 2011 consultations, and the southwestern willow flycatcher in the 2011 consultation, all with the same determination at those times and now, that they may be affected, but are not likely to be adversely affected by WS programs. We concur with your determination that WS activities may affect, but are not likely to adversely affect these species.

California condor. The California condor has only frequented the state of Colorado a few times, that we are aware of, since its near-extinction and subsequent reintroductions from captivity to California, Arizona, and Mexico. It is not a regular resident of the state and does not nest here. Nevertheless, WS takes a few precautions for the condor as outlined in the 1992 BO and 2016 BA (WS 2016a) where condors have been found (e.g., restrictions on the use of M-44s and the use of non-lead ammunition). Given this, we believe effects to the California condor are discountable and we concur with your determination that WS activities in Colorado may affect, but are not likely to adversely affect this species.

Gunnison sage-grouse. According to the BA, two routine PDM methods may disturb Gunnison sage grouse. Aerial predator damage management and calling and shooting coyotes with or without decoy dogs may disturb Gunnison sage-grouse on leks during late winter and early spring. WS Colorado conducts aerial predator damage management on Cerro Mesa, Sapinero Mesa (Gunnison Basin) and near Crawford 0-2 times per year for 15-30 minutes per location to remove coyotes that may depredate sheep. Eleven aerial predator damage management flights were conducted over 5 years with only 2 flights occurring after March 15 when lekking activity typically increases. Gunnison sage grouse were observed on leks during aerial operations over the years with about half the grouse staying on the lek and the other half dispersing into the sagebrush. Calling and shooting coyotes with or without the aid of decoy dogs has resulted in the dog or WS employee walking by or running by sage-grouse with grouse displaying various behaviors from observation, hiding, and walking away from the dog or WS employee. These interactions are infrequent and do not happen in all years. In summary, the disturbances are infrequent and of short duration, resulting in no significant effects to the Gunnison sage grouse.

The removal of coyotes to protect sheep may also have collateral benefits to Gunnison sagegrouse by removing a potential predator of sage-grouse. WS Colorado has conducted limited raven damage management to protect Gunnison sage-grouse at one satellite population as well. And, as outlined in the BA, a standard operating procedure (SOP) for Gunnison sage-grouse states that no new fencing would be constructed within occupied habitat (preferred), or if it is necessary, the top wire strand would need to be marked within 1000 meters of any lek to reduce grouse-fence collisions (WS 2016e). Given these conservation measures, we believe sagegrouse/fence collisions due to WS activities would be discountable. We concur with your determination that WS PDM activities, including coyote control and fencing, may affect, but are not likely to adversely affect this species.

Gray wolf. Since 2004, a small number of wolves (less than 10) have been sighted in 4 or 5 counties in northern Colorado; no denning or reproduction has been documented. Many tools used in PDM, primarily those used for predators including foothold traps, snares, M-44s, and aerial predator damage management, have the potential for taking a wolf. Snares, foothold traps, and M-44s are not allowed for use on public lands, but could be used on private lands. Wolves would not be purposefully targeted for capture or control.

Conservation measures to prevent taking a wolf are provided in the BA. These measures would be employed by WS within an easily defined area containing past wolf observations: Highway 13 (Moffat County) from the Wyoming border south to Craig, then east on Highway 40 to Steamboat Springs, then south on Highway 131 to Interstate 70, where the southern boundary will run east along Interstate 70 to Interstate 25 (eastern border), where the boundary will turn north to the Wyoming border; the Wyoming border between Highway 13 and Interstate 25 will be the northern boundary (WS 2016b). This area could be adjusted cooperatively by WS and the Service in the future based on updated wolf location information. Within the area potentially occupied by wolves: a) M-44s and neck snares would not be used, b) non-lethal foothold traps and leg snares could be used on private land by WS personnel, but would be checked daily, c) no aerial predator shooting would occur September 1 through November 30 (when young wolves and coyotes can be of similar size), d) body snares would have a break-away mechanism (strong enough to hold a coyote, but not a wolf), e) thermal imagers or night vision would be used when calling and shooting coyotes after dark (to more accurately identify the target species), and f) sirens or calls would be used to make coyotes howl prior to shooting coyotes (WS 2016a, 2016c). Additionally, Livestock Protection Collars would not be used and are not registered for use in Colorado (WS 2016d). Given these conservation measures, and the low likelihood of a wolf ever encountering any PDM device or WS personnel in Colorado, we concur with your determination that WS activities may affect, but are not likely to adversely affect this species.

Canada lynx. As stated in the BA, PDM implemented by WS Colorado continues to be the same as that identified in the 2009-2010 consultation (WS 2009, Service 2010), which addressed the effects of the WS Colorado program on the Canada lynx. The WS Colorado program has never taken a lynx as part of any livestock protection or other damage management programs. The only lynx that have been captured by WS were those intentionally captured for Colorado Parks and Wildlife as part of the reintroduction and monitoring effort. Given that the WS program in Colorado has not changed, including the lynx conservation measures identified in the 2009-2010 consultation, and we have no evidence that the status of the lynx in Colorado has appreciably changed since that time, our 2010 biological opinion remains effective and valid.

Black-footed ferret. The 1992 BO on the national WS program (Service 1992) addressed effects to the fully endangered, non-reintroduced, "wild," black-footed ferret. That was prior to any black-footed ferret reintroductions into Colorado. Given that the entire state of Colorado has now been block-cleared (Service 2009, 2013a), we do not believe there are any remaining nonreintroduced ferrets. Given this, it is our opinion that the reasonable and prudent alternatives (RPAs) contained in the 1992 BO are no longer necessary in Colorado. Those 1992 RPAs were largely designed to safeguard any remaining, undetected ferrets in unsurveyed areas from WS actions, primarily prairie dog control. We now believe that there are no remaining, nonreintroduced black-footed ferrets. Since 1992, the black-footed ferret has been reintroduced into various locations in the state, however, as explained below.

Evidence indicates that the ferrets reintroduced to the Wolf Creek Management Area (within the Colorado/Utah Experimental, nonessential Population Area (NEP Area) designated under section 10(j) of the ESA (63 FR 52824)) have been exterminated by plague and no longer exist (as stated in the BA). There may be a few reintroduced ferrets just over the Colorado border that are part of the Coyote Basin and Snake John populations in Utah. These ferrets would still be in the Experimental Population Area. WS has agreed not to conduct any prairie dog damage management in the Coyote Basin or Snake John Reef areas adjacent to Rio Blanco or Moffat Counties without consulting further with the Service.

Separate consultations have been conducted for the various reintroduced ferrets on the east side of the continental divide in Colorado—a BO was issued for the ferrets reintroduced under a safe harbors agreement (Service 2013) and a BO was issued for the ferrets reintroduced to the Rocky Mountain Arsenal NWR (Service 2015). Those BOs provide incidental take coverage for any action affecting ferrets that leave the management zone identified for those reintroduced populations, which would include WS actions. The WS BA states that "WS will only conduct prairie dog damage management outside of Management Zones as part of a Safe Harbor Agreement for the NEP. Should WS need to conduct damage management of a prairie dog population within the Conservation Zone of a Safe Harbor Agreement for NEP, WS will consult with USFWS prior to conducting the project." No further section 7 consultation on the WS PDM program is necessary at this time for the black-footed ferret.

If new information becomes available, new species listed, or should there be any significant changes to the project which alter the operation of the project, or the extent of the anticipated impact, from that which is described in this memo or which may affect any endangered or threatened species in a manner or to an extent not considered in the proposed action, section 7 consultation should be reinitiated. If the Service can be of further assistance, please contact Creed Clayton at (970) 628-7187.

Sincerely,

DRUE DEBERRY

Digitally signed by DRUE DEBERRY
Date: 2016.11.18 15:49:47 -07'00'

Drue DeBerry
Acting Colorado Field Supervisor

Cc: US Fish & Wildlife, Law Enforcement Officer, Edward_Meyers@fws.gov

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APPENDIX E. APHIS-WS RESPONSE TO 2016 EVALUATION OF PREDATOR CONTROL STUDIES BY DR. ADRIAN TREVES, MIHA KROFEL AND JEANNINE MCMANUS

On September 1, 2016, researchers from the University of Wisconsin-Madison*, University of Ljubljana, and University of Witwatersrand released a publication entitled "Predator control should not be a shot in the dark" (Treves et al. 2016). The researchers evaluated 12 existing publications (5 non-lethal and 7 lethal methods) regarding the effectiveness of nonlethal and lethal methods for reducing predation on livestock. Their main conclusions included the following:

1. Predator control methods to prevent livestock loss have rarely been subject to rigorous tests using the "gold standard" for scientific inference (random assignment to control and treatment groups with experimental designs that avoid biases in sampling, treatment, measurement, or reporting)
2. Across the controlled experiments that they systematically examined, higher standards of evidence were generally applied in tests of non-lethal methods than in tests of lethal methods for predator control
3. Non-lethal methods were more effective than lethal methods in preventing carnivore predation on livestock generally; at least two lethal methods (government culling or regulated, public hunting) were followed by increases in predation on livestock; zero tests of non-lethal methods had counterproductive effects
4. All flawed tests came from North America; ten of 12 flawed tests were published in three journals, compared to four of 12 tests with strong inference in those same journals
5. Treves et al. (2016) recommend suspending lethal predator control methods that do not currently have rigorous evidence for functional effectiveness in preventing livestock loss until gold standard tests are completed.

Specific Points Regarding Treves' Article:

•Treves et al. (2016) recommend wildlife researchers apply the same standards used in controlled, laboratory settings to wildlife field research. Such standards (which involve randomized, controlled trials) are often not possible in field studies for a variety of reasons:

- First, it can be difficult to find comparable units for evaluation. In the case of predation management, finding multiple field study sites that not only prohibit predator control, but also allow ranching, is difficult. Almost by definition, ranchers with high predation rates usually try to control predators, and ranchers with minimal problems do not.
- Second, field studies involve a lot of variation. There are many factors from the weather to varying habitats to the movement of wildlife in and out of study areas that cannot be controlled and may impact results. This is the inherent nature of field work.
- Finally, to give sufficient statistical power, sample sizes must be large. Gathering sufficient data often involves multiple field seasons and field experts. Funding and other resources can limit the ability to conduct such studies.

•To conduct a completely randomized design as suggested by Treves et al. (2016) would result in inherently large variability among sites and would necessitate such a large sample size that it would not be possible or practical in most instances. Two alternative field designs that are commonly used in wildlife research include a switch-back and paired block approach.

- In the case of a predator control study, a switch-back design would involve at least two study areas, one (or more) with predator control and one (or more) without predator control. After at least 2 years of data collection, the sites would switch so that the one with predator control becomes the one without predator control and vice versa. An additional 2 years of data collection would occur. Wildlife Services researchers are currently involved in a controlled switch-back study like the one described above that is investigating the effectiveness of coyote control for reducing predation on deer populations in Utah.

- The paired block design, involves finding multiple sites that are similar that can be paired and compared. For each pair, one site would experience predator control and one would not.

•Treves et al.'s sloppy assessment of existing predation studies from North America and Europe causes us to question his ability to accurately critique the scientific literature. Treves et al.'s critique of a least two of the studies reviewed in their paper did not accurately interpret or represent the studies' designs and results.

- In regards to Wagner and Conover (1999), Treves et al. (2016) makes a fundamental error in interpreting the study design. When researchers make changes to the independent variable, they measure the changes in the dependent variable. The purpose of the study was to determine the impact of preventive aerial operations (independent variable) as currently practiced by the WS program on sheep losses the following summer (dependent variable) and the need for subsequent corrective predator damage management (i.e., the use of traps snares and M-44s - also a dependent variable) during the subsequent summer. Treves et al. (2016) mistakenly characterize use of traps, snares and M-44s as independent variables which indicates a fundamental inattentiveness to the details of the study. This error led the authors to erroneously claim a variation that occurred in response to the treatment was either a willful misapplication of a control variable or a gross failure in study design. Wagner and Conover (1999) purposefully allowed corrective predator damage management to be conducted during the summer following aerial operations because, as practiced, it was highly improbable that preventive aerial operations would ever be used to the exclusion of all other methods for corrective predator damage management. Furthermore, if preventive aerial operations were effective, authors predicted one of two outcomes:

1) losses on areas without aerial operations would be lower than losses in areas with aerial operations and there would be a corresponding decrease in use of traps, snares and M-44s; or,
2) increased use of corrective predation management during the summer could be sufficient to keep losses at levels similar to areas with preventive aerial operations, but the amount of summer corrective predation damage management would be higher in areas without aerial operations.

Traps, snares and M-44s pose substantially different risks to non-target species than aerial operations. Wagner and Conover (1999) felt that this information was important when making management decisions regarding the use of preventive aerial operations.

Treves et al. (2016) also states that the study is biased because "control pastures started with 40% higher sheep densities." However, Treves et al.'s calculation of sheep densities was based on incomplete information and is not a valid interpretation of the density of sheep during the study period. In the study, sheep were not permitted to disperse evenly throughout the grazing allotments, instead, herders move sheep bands through subsections of the allotments in accordance with established grazing management plans. Consequently, simply dividing the number of sheep on the allotment by the total size of the allotment, as was done, does not accurately reflect the density of sheep during the study.

Treves et al. states the study includes a reporting bias because "data was not presented" on livestock-guarding dogs. Wagner and Conover (1999) clearly states that one of the criterion used for pairing allotments was the presence or absence of livestock guarding dogs (LGD). They did not pair allotments with LGDs with allotments without LGDs. Failure to provide data showing that that number of treated allotments with LGDs matched the number of untreated allotments with LGDs does not constitute a reporting bias.

Treves et al. misrepresents another study conducted by Dr. Eric Gese (WS-NWRC) and a Utah State University collaborator on a study site in western Wyoming. Treves et al. confuses two different studies when citing Bromley and Gese (2009) on page 23. The Bromley and Gese (2001a, 2001b) study examined coyote predation on domestic sheep; in contrast, the Seidler and Gese (2012) study examined coyote predation on pronghorn antelope fawns. While citing Bromley and Gese (2009), Treves et al. (2016) is actually referring to a paper published in 2001 (Bromley and Gese 2001a). As a reason for study bias, they mention that Bromley and Gese's study includes a high overlap between coyote territories.

The statistics mentioned actually come from a completely different study (Seidler and Gese 2012) that was conducted in a different State (southeastern Colorado), 7 years later, and in a completely different system (i.e., no sheep). The Bromley and Gese (2001b) publication actually reports that coyote core areas overlapped only once (by 3%) and there was no significant difference in overlap among sterile and intact coyote packs. In fact, to eliminate a potential inaccurate assignment of the coyotes responsible for making a kill, Bromley and Gese used the actual locations of the radioed coyotes as the method of assigning which pack killed the sheep whenever there was overlap of territory boundaries between adjacent packs.

Additionally, Treves et al. incorrectly states that the estimates of weekly survival rates are not biologically significant. However, they used data from all the packs which is inappropriate as not all packs killed sheep. By only using data from sheep-killing packs and doing some simple math, they would have concluded that a weekly survival rate of 0.997 in the sterile packs equates to 94% of the lambs surviving for the next 6-months (beyond which they are no longer vulnerable to predation), versus a weekly survival rate of 0.985 in the intact packs which equates to 72% of the lambs surviving for the next 6 months. Therefore, sterilization would provide 22% higher survival of lambs which is quite biologically and economically significant to a livestock producer.

The correct references are:

Bromley, C., and E. M. Gese. 2001a. Surgical sterilization as a method of reducing coyote predation on domestic sheep. Journal of Wildlife Management 65(3):510-519.

Bromley, C., and E. M. Gese. 2001b. Effects of sterilization on territory fidelity and maintenance, pair bonds, and survival rates of free-ranging coyotes. Canadian Journal of Zoology 79(3):386-392.

Treves et al. (2016) include a paper by (Musiani et al. 2003) whereby they claim fladry (a method for controlling wolves) was experimentally tested. But in fact the experimental portion of the work was done on captive animals. The two field trials included in the paper did not meet the scientific standards outlined by Treves. This was either purposefully deceptive or sloppy.

Treves et al. (2016) selectively disregards studies from Australia. These studies are some of the more rigorous field studies on working livestock operations with free-ranging, native carnivores that evaluate the effectiveness of lethal control. Given their explicit desire to make generalization about predation control, it is odd that they would purposefully exclude this body of rigorous science.

WS understands and appreciates interest in ensuring predator damage management methods are as robust and effective as possible. WS supports the use of rigorous, scientifically-sound studies, but we realize there are many variables that cannot be controlled and assumptions that must be acknowledged when trying to answer complex ecological questions. We do not believe there is a single standard for conducting wildlife field studies and each approach or design has its own unique assumptions, drawbacks and challenges. WS does not believe that results from existing studies should be ignored. Wildlife research is inherently challenging because scientists are not working in a “closed” system. Science and the scientific method are a process. You build upon information gathered over years of study and experimentation. Results from one study lead to new questions and new studies.

WS’ policies and decisions are based on the best available science. The National Environmental Policy Act (NEPA) requires federal agencies to evaluate environmental impacts into their decision making processes and ensures that environmental information is available to public officials and citizens before decisions are made and actions are taken. To fulfill this responsibility, Wildlife Services prepares analyses of the environmental effects of program activities as part of the NEPA process. A description of and citations for various wildlife damage management actions can be found in the program’s Environmental Assessments and Environmental Impacts Statements which are available by State on the APHIS website.

Wildlife Services encourages the use of nonlethal predation damage management tools and techniques when feasible and practical, however, not all wildlife damage problems can be resolved using nonlethal techniques alone. Even with the use of single or combined nonlethal methods, livestock losses to predators often continue. When conducting lethal management activities, Wildlife Services evaluates all potential tools for humaneness, effectiveness, ability to target specific individual animals and/or species, and the potential impact on human safety. Professional organizations such as The Wildlife Society (TWS), whose 10,000 members include scientists, managers, educators and others, have long supported the use of lethal take. TWS's Standing Position Statement on Wildlife Damage Management states, "Prevention or control of wildlife damage, which often includes removal of the animals responsible for the damage, is an essential and responsible part of wildlife management." It is important to note that Wildlife Services is tasked with reducing wildlife damage. We do not manage wildlife populations. The management of predators and other wildlife is the responsibility of the States and other federal agencies. As such, any actions undertaken to reduce wildlife damage are conducted in collaboration with State agencies and under appropriate State and federal permits and laws.

Appendix F. Federal Laws and Executive Orders Relevant to WS-Colorado Actions

Federal Laws

For relevant state laws, see Section 2.4.4 of this EA.

National Environmental Policy Act (NEPA)

Most federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). When APHIS-WS enters into an agreement to assist another federal agency to manage wildlife damage hazards, the other federal agency must also comply with NEPA. APHIS-WS policy is to work together for compliance. NEPA requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes. The two primary objectives of the NEPA are: 1) agencies must have available and fully consider detailed information regarding environmental effects of federal actions and 2) agencies must make information regarding environmental effects available to interested persons and agencies before decisions are made and before actions are taken.

APHIS-WS complies with CEQ regulations implementing the NEPA (40 CFR 1500 - 1508) along with USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Pursuant to the NEPA and CEQ regulations, WS NEPA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions. NEPA documents are prepared by integrating as many of the natural and social sciences as relevant to the decisions, based on the potential effects of the proposed actions. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

Pursuant to the NEPA and CEQ regulations, WS NEPA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions.

Endangered Species Act

Under the ESA (16 United States Code (U.S.C.) 1531 et seq., Endangered Species Act (ESA) of 1973, as amended; 16 U.S.C. 703-712), all federal agencies will seek to conserve threatened and endangered species and will utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). WS conducts Section 7 consultations with the United States Fish and Wildlife Service (USFWS) to use the expertise of the USFWS to ensure that "any action authorized, funded or carried out by such an agency…is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency will use the best scientific and commercial data available" (Sec.7 (a)(2)). Depending on the species, the US Fish and Wildlife Service (USFWS) and the NOAA National Marine Fisheries Service (NMFS) are charged with implementation and enforcement of the Endangered Species Act of 1973, as amended and with developing recovery plans for listed species. Under the authority of the ESA, the USFWS acts to prevent the extinction of plant and animal species. It does this by identifying species at risk of extinction, designating ("listing") these species as threatened or endangered, providing protection for these species and their habitats, developing and implementing recovery plans to improve their status, and ultimately "delisting" these species and returning full management authority to the states and tribes. While a species is listed, most management authority for the species rests with the USFWS/NMFS. However, the agencies continue to work with other Federal agencies, states, and tribes along with private landowners to protect and recover the species. The USFWS helps ensure protection of listed species through consultations (section 7 of the ESA) with other Federal agencies. Under section 10 of the ESA, the USFWS also issues permits which provide exceptions to the prohibitions established by other parts of the Act. These permits provide for conducting various activities including scientific research, enhancement of propagation or survival, and incidental take while minimizing potential harm to the species. For species federally classified as threatened, the USFWS may also issue 4(d) rules which may allow for greater management flexibility for the species. The USFWS also issues grants for protection and enhancement of habitat and for research intended to improve the status of a listed species.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Amendments

FIFRA is the primary act under which the registration of pesticides is regulated. FIFRA authorizes Federal agencies to regulate the distribution, sale, and use of pesticides to protect human health and the environment. FIFRA authorizes EPA to review and register pesticides for specified uses. EPA also has the authority to suspend or cancel the registration of a pesticide if subsequent information shows that the continued use would pose unreasonable risks.

All pesticides distributed or sold in the United States must first be registered by EPA, and then within the individual State where it is being distributed, sold, or used. The EPA registration process requires that pesticides will be properly labeled and that, if used in accordance with the label, the pesticide should not cause unreasonable harm to humans or the environment. FIFRA does not fully preempt state, tribal, or local law, therefore each entity may also further regulate pesticide use.

National Historic Preservation Act (NHPA) of 1966, as amended

The NHPA and its implementing regulations (36 CFR 800) require federal agencies to initiate the section 106 process if an agency determines that the agency's actions are undertakings as defined in Sec. 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under section 106. The Advisory Council on Historic Preservation (ACHP) and each state's State Historic Preservation Officer (SHPO) or the tribal government Tribal Historic Preservation Officer THPO) have the primary non-regulatory jurisdiction. If an individual activity with the potential to affect historic resources is planned under an alternative selected as a result of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted with the SHPO or THPO as necessary.

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (Public Law 101-106, 25 USC 3001) requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal agencies are to discontinue work until the agency has made a reasonable effort to protect the items and notify the proper authority.

The Wilderness Act (Public Law 88-577; 16 USC 1131-1136)

The Wilderness Act established a national preservation system to protect areas "where the earth and its community life are untrammeled by man" for the United States. Wilderness areas are devoted to the public for recreational, scenic, scientific, educational, conservation, and historical use. This includes the grazing of livestock where it was established prior to the enactment of the law (Sept. 3, 1964) and damage management is an integral part of a livestock grazing program. The Act did leave management authority for fish and wildlife with the state for those species under their jurisdiction.

Coastal Zone Management Act of 1972, as amended (16 USC 1451-1464, Chapter 33; P.L. 92-583, October 27, 1972; 86 Stat. 1280).

This law established a voluntary national program within the Department of Commerce to encourage coastal states to develop and implement coastal zone management plans. Funds were authorized for cost-sharing grants to states to develop their programs. Subsequent to federal approval of their plans, grants would be awarded for implementation purposes. In order to be eligible for federal approval, each state's plan was required to define boundaries of the coastal zone, identify uses of the area to be regulated by the state, determine the mechanism (criteria, standards or regulations) for controlling such uses, and develop broad guidelines for priorities of uses within the coastal zone. In addition, this law established a system of criteria and standards for requiring that federal actions be conducted in a manner consistent with the federally approved plan. The standard for determining consistency varied depending on whether the federal action involved a permit, license, financial assistance, or a federally authorized activity. As appropriate, a consistency determination would be conducted by WS to assure management actions would be consistent with the particular state's Coastal Zone Management Program established under the Coastal Zone Management Act CGS Sections 22a-90 to 22a-111.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA; 16 USC 703-712), as amended, provides the USFWS regulatory authority to protect native species of birds that migrate outside the United States. The law prohibits any "take" of these species, except as permitted by the USFWS. The MBTA established a federal prohibition, unless permitted by regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird. FWS released a final rule on November 1, 2013 identifying 1,026 birds on the List of Migratory Birds [78 Fed. Reg. 212(65844-65864)]. Species not protected by the Migratory Bird Treaty Act include nonnative species introduced to the United States or its territories by humans and native species that are not mentioned by the Canadian, Mexican, or Russian Conventions that were implemented to protect migratory birds [78 Fed. Reg. 212(65844-65864)]. Based on evidence that migratory game birds have accumulated in such numbers to threaten or damage agriculture, horticulture or aquaculture, the Director of the USFWS is authorized to issue a depredation order or special use permit, as applicable, to permit the killing of such birds (50 CFR 21.42-47). In severe cases of bird damage, APHIS-WS provides recommendations to the USFWS for the issuance of depredation permits to private entities (50 CFR 21.41). Starlings, pigeons, House Sparrows and domestic waterfowl are not classified as protected migratory birds and therefore have no protection under the MBTA. USFWS depredation permits are also not required for Yellow-headed, Red-winged, and Brewer's Blackbirds, cowbirds, all grackles, crows, and magpies found committing or about to commit depredation upon ornamental or shade trees, agricultural crops, livestock, or wildlife, or when concentrated in such numbers and manner as to constitute a health hazard or other nuisance (50 CFR 21.43).

Bald and Golden Eagle Protection Act (BGEPA)

This law provides special protection for bald and golden eagles. Similar to the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.) prohibits the take of bald or golden eagles unless permitted by the Department of the Interior. The term "take" in the Act is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." Disturb is defined as any activity that can result in injury to an eagle, or cause nest abandonment or decrease in productivity by impacting breeding, feeding, or sheltering behavior.

Occupational Safety and Health Act of 1970

The Occupational Safety and Health Act of 1970 and its implementing regulations (29 CFR 1910) on sanitation standards states that, "Every enclosed workplace shall be so constructed, equipped, and maintained, so far as reasonably practical, as to prevent the entrance or harborage of rodents, insects, and other vermin. A continuing and effective extermination program shall be instituted where their presence is detected." This standard includes mammals that may cause safety and health concerns at workplaces.

Federal Food, Drug, and Cosmetic Act (21 USC 360)

This law places administration of pharmaceutical drugs, including those immobilizing drugs used for wildlife capture and handling, under the Food and Drug Administration.

Controlled Substances Act of 1970 (21 USC 821 et seq.)

This law requires an individual or agency to have a special registration number from the United States Drug Enforcement Administration to possess controlled substances, including controlled substances used for wildlife capture and handling.

Animal Medicinal Drug Use Clarification Act of 1994

The Animal Medicinal Drug Use Clarification Act (AMDUCA) and its implementing regulations (21 CFR 530) establish several requirements for the use of animal drugs, including those animal drugs used to capture and handle wildlife in damage management programs. Those requirements are: (1) a valid "veterinarian-client-patient" relationship, (2) well defined record keeping, (3) a withdrawal period for animals that have been administered drugs, and (4) identification of animals. A veterinarian, either on staff or on an advisory basis, would be involved in the oversight of the use of animal capture and handling drugs under any alternative where WS-Colorado would use those immobilizing and euthanasia drugs. Veterinary authorities in each state have the discretion under this law to establish withdrawal times (i.e., a period after a drug was administered that must lapse before an animal may be used for food) for specific drugs. Animals that people might consume within the withdrawal period must be identifiable (e.g., use of ear tags) and labeled with appropriate warnings.

Fish and Wildlife Act of 1956 (section 742j-1) - Airborne Hunting

The Airborne Hunting Act, passed in 1971 (Public Law 92-159), and amended in 1972 (Public Law 92-502) was added to the Fish and Wildlife Act of 1956 as a new section (16 USC 742j-l). The USFWS regulates the Airborne Hunting Act but has given implementation to the States. This act prohibits shooting or attempting to shoot, harassing, capturing or killing any bird, fish, or other animal from aircraft except for certain specified reasons. Under exception [see 16 USC 742j-l, (b)(1)], state and federal agencies are allowed to protect or aid in the protection of land, water, wildlife, livestock, domesticated animals, human life, or crops using aircraft.

Presidential Executive Orders

Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (Executive Order 12898)

Executive Order 12898 promotes the equitable treatment of people of all races, income levels, and cultures with respect to the development and implementation of federal actions, and enforcement of environmental laws, regulations and policies. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address, when appropriate, disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income persons or populations.

Protection of Children from Environmental Health and Safety Risks (Executive Order 13045)

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. This executive order requires federal agencies to evaluate and consider during decision-making the adverse impacts that the federal actions may have on children.

Invasive Species (Executive Order 13112)

Executive Order 13112 establishes guidance for federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm or harm to human health. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species. This EO created the National Invasive Species Council (NISC).

Consultation and Coordination with Indian Tribal Governments (EO 13175)

This EO directs federal agencies to provide federally recognized tribes the opportunity for government-to-government consultation and coordination in policy development and program activities that may have direct and substantial effects on their tribe. Its purpose is to ensure that tribal perspectives on the social, cultural, economic, and ecological aspects of agriculture, as well as tribal food and natural-resource priorities and goals, are heard and fully considered in the decision-making processes of all parts of the Federal Government.

Facilitation of Hunting Heritage and Wildlife Conservation (Executive Order 13443)

This order directs Federal agencies that have activities that have a measurable effect on outdoor recreation and wildlife management, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat. It directs federal agencies to cooperate with states to conserve hunting opportunities. APHIS-WS cooperates with state wildlife and other resource management agencies in compliance with applicable state laws governing feral swine management. State, territorial, and tribal agencies, not APHIS, have the authority to determine which species are managed as a game species, hunted, eradicated, contained, or managed for local damages.

Incorporating Ecosystem Services into Federal Decision Making (Presidential Memorandum 10/7/2015)

This memorandum directs Federal agencies to develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments, and regulatory contexts. This effort includes using a range of qualitative and quantitative methods to identify and characterize ecosystem services, affected communities' needs for those services, metrics for changes to those services, and, where appropriate, monetary and nonmonetary values for those services. It also directs Federal agencies to integrate assessments of ecosystem services, at the appropriate scale, into relevant programs and projects, in accordance with their statutory authority.

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Appendix G. Colorado Parks and Wildlife Study Plan: Addressing Neonate Mule Deer Survival in the Piceance Basin

PROGRAM NARRATIVE STUDY PLAN
FOR MAMMALS RESEARCH
FY 2016-17

State of:	Colorado	:	Parks and Wildlife
Cost Center:	3430	:	Mammals Research
Work Package:		:	
Task No.		:	
		:	
Federal Aid Project No.			

Addressing Neonate Mule Deer Survival in the Piceance Basin

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STUDY PLAN APPROVAL

Prepared by:	Chuck Anderson	Date:	January 28, 2016
Submitted by:	Chuck Anderson	Date:	August 18, 2016
Reviewed by:	Eric Bergman	Date:	February 17, 2016
	Mat Alldredge	Date:	February 9, 2016
	Darby Finley	Date:	February 8, 2016
Biometrician:	Jon Runge	Date:	Pending

PROGRAM NARRATIVE STUDY PLAN
FOR MAMMALS RESEARCH
FY 2016-17 – FY 2018-19

Addressing Neonate Mule Deer Survival in the Piceance Basin

A Study Plan Proposal Submitted by:
Chuck Anderson, Mammals Research Leader, Colorado Parks and Wildlife

A. NEED

The Piceance Basin in northwest Colorado (GMU 22) represents winter range supporting the largest migratory mule deer (*Odocoileus hemionus*) population in Colorado. This area has been the focus of research and monitoring efforts since the late 1940's and likely represents one of the best documented mule deer populations in North America. Research efforts conducted during the 1980s (Bartmann et al. 1992) documented a high density deer population (mean winter density = 63/km^2) that appeared to be at or near carrying capacity. During the early 1990s, this population declined to about 1/3 of the previous winter range density (mean winter density = 23/km^2; White and Bartmann 1998), likely due to exceeding the forage capacity on winter range.

Thirteen years later (January 2008), another research effort was initiated to address mule deer/energy development interactions in the Piceance Basin (Anderson 2015; Federal Aid Project No. W-185-R), where similar data are being collected to provide comparisons to mule deer demographic data from the 1980s and early 1990s. In comparing data between the 2 time periods (1982-1990 before the decline and 2008-present from unmanipulated control areas): (1) December fawn weights have increased (averaging 3.7 kg heavier), (2) over-winter fawn survival (Dec – June) has more than doubled (averaging 0.737 versus 0.351), and (3) winter starvation has become rare (<3% of collared fawns), which was common during the 1980s (averaging 33% annually), which suggests mule deer in the Piceance Basin are no longer limited by habitat conditions. Further evidence that this population is no longer limited by forage conditions is evident in the animal-indicated Nutritional Carrying Capacity (NCC; Monteith et al. 2014) from doe body condition measurements providing annual lamda estimates ranging from 1.01 – 1.04 (values >1.0 suggest the population is below NCC), except during 2011 when lamda was slightly below 1.0.

While current research (Anderson 2015; Federal Aid Project No. W-185-R) indicates habitat no longer appears to be the limiting factor, annual winter fawn recruitment has declined from ~73 fawns/100 does to ~49 fawns/100 does, and the average mule deer densities since 2008 (mean late winter density = 19.1/km^2) are comparable to the relatively low levels observed during 1994 and 1995 (mean mid-winter density = 23.5/km^2; White and Bartmann 1998). Because over-winter fawn survival is high, but early winter fawn recruitment appears low, there is need to discern why fewer fawns may be arriving on winter range in the Piceance Basin. Data collected during the ongoing research largely rules out issues surrounding low fecundity as measured pregnancy and twining rates have been consistently high averaging 95% since 2009 and 1.75 in utero fawns/doe. Thus, evidence suggests that wildlife biologists need information to better understand early fawn survival, from birth until December.

Newborn fawn survival has been addressed in the Piceance Basin the past 4 years (in partial collaboration with Colorado State University). Thus far, neonate survival has been relatively low (~40%) with a large portion of mortality attributed to predation (at least 49% of collared fawns) and low frequency of malnutrition (<4%). This suggests predation may be limiting neonatal (i.e., 0–6 months old, June – December) survival and recruitment to winter range if predation is additive to other types of mortality (e.g., disease, starvation). Monteith et al. (2014) reported high predation rates of mule deer neonates in California (>60% bear predation) and document that predation rather than nutrition was limiting the population.

Past research evaluating success of predator reduction to enhance ungulate populations has provided mixed results. Hurley et al. (2010) addressed coyote (*Canis latrans*) and cougar (*Puma concolor*) reduction to enhance mule deer populations in Idaho. They reported that coyote predation of mule deer was related to lagomorph abundance and coyote control exhibited no influence on early winter fawn recruitment. However, cougar reduction resulted in increased survival and winter fawn recruitment, but was largely ineffective when environmental factors (drought, severe winters) limited mule deer populations. Keech et al. (2011) addressed wolf (*C. lupus*) and bear (*Ursus* spp.) predation on moose (*Alces alces*) in Alaska and noted that predator reduction enhanced moose populations when environmental factors were non-limiting (i.e., during summer, fall). Predator reduction may benefit prey populations when they are not limited by habitat/environmental conditions, when predation is identified as a limiting factor, and when predator reduction is focused in scale to effectively reduce predation rates and timed to address critical periods in prey survival (Mule Deer Working Group 2012).

To address the reason for declining winter fawn recruitment in the Piceance Basin and identify potential management options, we propose to continue monitoring newborn fawn survival for another 3 years, while simultaneously implementing short-term and focused predator control in a treatment area and comparing fawn survival to an unmanipulated control area (Figure 1). This information will provide evidence to determine if predation is additive or compensatory to other types of mortality (e.g., disease, starvation). If neonate predation appears additive to other forms of mortality, focused predator reduction during mule deer parturition may be useful to enhance neonate survival and recruitment in mule deer populations experiencing decline and not limited by environmental conditions. If, on the other hand, neonate predation appears compensatory, predator management should be disregarded as a management option to enhance neonate survival and recruitment. Conditions in the Piceance Basin are comparable to other western Colorado mule deer populations where high winter fawn survival and low starvation frequency has been documented and this information will likely be applicable to declining or below objective deer herds in the western third of the state exhibiting factors inconsistent with climate or habitat limitations (e.g., low starvation frequency, good forage conditions).

B. OBJECTIVES

To assess neonate mule deer survival and recruitment in the Piceance Basin in response to predator control of black bears (*U. americanus*) and cougars, this project will evaluate focused predator removal efforts just prior to and during the spring birthing period on a summer range treatment area for the next 3 years and comparing neonate survival rates to an unmanipulated control area. Comparisons to 4 years of pretreatment survival rates in the treatment and 3 years in the control area (Peterson 2016) will also be available to address the additive or compensatory nature of predation on neonate mule deer survival.

C. EXPECTED RESULTS OR BENEFITS

1) Address additive or compensatory nature of predation relative to neonate mule deer survival and recruitment.
2) Evaluate the utility of spring predator management in enhancing mule deer fawn survival and recruitment.

D. APPROACH

Doe Captures and Demographic Data

Ongoing research to address mule deer/energy development interactions (Anderson 2015; Federal Aid Project No. W-185-R) will support adult female capture efforts early March 2017 to attach GPS radio-collars (G-2110D, Advanced Telemetry Systems, Isanti, MN, USA) and provide dam specific data for pregnancy status, fetal counts, and adult female body condition. Specific capture and handling procedures are addressed in Anderson and Freddy (2008) and Anderson (2015). Pregnant females on winter range will be equipped with vaginal implant transmitters (VITs; MOD M3930, Advanced Telemetry Systems, Isanti, MN, USA) to facilitate spring neonate capture and collaring efforts following birth on the predator reduction summer range (Fig. 1).

Neonate captures and monitoring

Daily fixed-wing aircraft flights will be used to monitor VITs and identify birth sites and timing on the predator treatment summer range. Once expelled VITs are detected, field crews will be directed to birth site locations to locate and capture newborn fawns. Neonate searches will typically last up to 30–45 minutes and will not exceed 1 hour. Due to past logistical complications during neonate captures on the control summer range (being more widely dispersed with private and remote land access complications), we plan to focus neonate capture efforts in a few high density areas targeting collared and uncollared adult females during parturition without the aid of VITs. Each neonate will be handled with sterile nitrile latex gloves to minimize the transfer of human scent, blindfolded, and placed in a cloth bag to measure body mass. Hind foot length, chest girth, age (days), and sex will also be recorded. Each neonate will be fitted with an expandable radio-collar (M4210, ATS, Isanti, MN, USA) with a 4 hour mortality sensor and designed to drop off after 8-10 months; radio-collars will be modified for drop-off by splicing the collar and inserting 2 lengths of rubber surgical tubing. Handling time will be ≤ 5 minutes and neonates will be placed in the precise location where they were located to minimize abandonment.

Neonate collar signals will be monitored daily from fixed wing aircraft while monitoring doe VITs and collar signals. After all VITs are expelled and/or accounted for, monitoring of neonate collar signals will continue daily from the ground and from fixed wing aircraft weekly. Daily monitoring will afford us the ability to detect mortalities and assess fetal survival within 24 hours. Monitoring of neonate signals will continue until a mortality signal is detected. Once detected, neonates and/or collars will be located from the ground or air and if any part of a carcass is present a thorough field necropsy will be conducted to determine cause-specific mortality.

Addressing Differences in Survival

Preliminary results will be reported annually using age-specific Kaplin-Meier survival estimation. Final analyses will be conducted using multi-state survival estimation methods

(Lebreton et al. 2009) in Program MARK (White and Burnham 1999). Each neonate mortality will be assigned one of three states including predation, starvation, and other assuming a reduction in predation concurrent with an increase in survival. Sibling dependency and overdispersion in survival estimates will be addressed by conducting data-bootstrap analyses in Program MARK (Bishop et al. 2008).

Sample Size

A total of 55-60 pregnant females will receive VITs during March captures from the winter range study areas (Fig. 1). Because past fetal counts have averaged 1.75 (C. Anderson, unpublished data) and assuming a small number of VIT failures and that some adult females will be inaccessible on summer range, we conservatively estimate a minimum of 60 neonate captures on the predator treatment summer range (Fig. 1). A minimum of 40 neonates will be targeted from the control study area. Bishop et al. (2009) reported statistical power (1-β) of 0.81 to detect a 15% difference in neonate survival assuming survival of control fawns = 0.40, which is consistent with previous neonate survival rates in the Piceance Basin. Thus, sample sizes from the previous 4 years (n = 55 – 85) and proposed sample sizes for the next 3 years should be sufficient to conservatively detect a 15% increase/difference in fawn survival following predator control assuming this mortality is additive.

Predator Reduction

Following guidelines from the Mule Deer Working Group (2012) to address the likely factor limiting fawn survival/recruitment (predation), applying focused predator reduction to sufficiently reduce predation rates (>15%), and identifying the critical survival period when habitat is non-limiting, we will focus predator control efforts on a relatively small summer range parturition area (1,277 km^2, Figure 1) during a 2 month period (May 1 – June 30) just prior to and during mule deer parturition. Because this area consists primarily of private lands limiting hunter access and spring hunting seasons are currently unavailable, USDA Wildlife Services (WS) will be contracted to address spring predator reduction efforts. A large portion of summer range in the predator treatment study area is owned by energy companies, most of which have been collaborators with the current mule deer/energy development research since 2008 (Anderson 2015). Ron Velarde (Northwest Regional Manager, CPW) will take the lead in arranging agreements between agencies and energy companies to conduct predator control efforts.

Because black bear predation has been most prevalent the past 4 years (averaging 14% of collared neonates), predator control efforts will focus on this species. Cougar (*Puma concolor*) predation has also been notable (averaging 8%) and therefore will be a secondary species for control efforts. Predation from other predatory species (coyotes, bobcats, golden eagles) has been relatively minor (averaging ≤5% per species) and therefore these species will not be targeted during predator control efforts; coyote (Hurley et al. 2010) and bobcat predation of mule deer may be more compensatory than cougar and black bear predation. Although average predation rates of 23% have been documented from black bears and cougars combined, a large portion of unknown predation (11%) and unknown mortality (9%) of neonates documented the past 4 years is likely also related to these predators. To illicit a significant effect on predation rates to adequately address the additive or compensatory influence on neonate survival, predation should be reduced by 20%. The level of predator removal required to achieve this reduction in overall predation is currently speculative given that we are n aware of previous research to addressed individual cougar and black bear predation rates for mule deer neonates. However, we propose that focal removal (targeting areas of past predation activity) of 5-10 cougars and 10-25 black bears annually will provide the desired predation rate reduction. Our approach will need to be flexible to insure we achieve the desired predation rate reduction of ≥20%. While the objective is to reduce cougar and black bear densities in this focal area, overall densities at the much larger Data Analysis Unit (DAU) scale (representing population level biological units) should be minimally influenced; the predator treatment summer range area (Fig. 1) represents 6% mountain lion DAU L-7 and 16% of black bear DAU B-1.

Cougar and black bear removal methods employed by WS will consist of cage traps, culvert traps, foot snares, and trailing hounds for capture and a firearm will be used for euthanasia. Although probability of capturing non-target species is low, the non-lethal capture methods employed will provide for immediate release during daily trapping efforts. NEPA requirements for this project are currently under review in an Environmental Assessment prepared by USDA Wildlife Services. All bears and cougars killed by WS personnel will be reported to CPW within 5 working days of the taking. Reporting shall consist of a CPW Bear and Lion Form completed by WS personnel and forwarded to CPW personnel. Required sample collections from each carcass will include meat and blood samples for stable isotope diet analysis and a first premolar for aging. WS personnel will make every effort to salvage all black bear and cougar hides and meat for CPW disposal or distribution. If the carcass is not salvageable, the entire carcass, including hide, head, feet, skull and gall bladder will be destroyed in the field immediately upon taking possession of the animal. WS personnel will destroy all bear gall bladders in the field. Whenever feasible, the carcass of bears and cougars will be properly cared for and transported to CPW, meat will be donated to needy families, and other parts will be destroyed or used for educational purposes. Family groups (females with young) will not be euthanized and will be translocated and released at least 50 km from the capture site.

E. Location

This research will occur on summer ranges for mule deer that occupy the Piceance Basin winter range in northwest Colorado (portions of Game Management Units 22, 31 and 32 in Moffat and Garfield counties; Fig. 1). Detailed study area and habitat descriptions are provided by Anderson (2015).

F. Schedule of Work

Activity	Date
Adult female captures on winter range (from ongoing research)	March 2017–2019
Black bear and cougar removal	May 1–June 30, 2017–2019
Neonate capture and collaring efforts	Late May–June 2017–2019

Neonate survival monitoring	Late May–mid Dec. 2017–2019
Data analyses and manuscript preparation	Dec. 2019–2020

G. Estimated Costs

FY 2016-17 (field work beginning May 2017)

Description	Unit cost	Sub total
Temporary personal services	14 technicians for 6 weeks	$ 59,555
Contract personal services	WS predator control	$ 50,000
Operating		
VITs	60 X $250	$ 15,000
Neonate collars	40 X $234	$ 9,360
Fixed-wing flights	48 hours X $314	$ 15,072
Rental trucks	3 X $3,300	$ 9,900
Rental truck tires	8 X $250	$ 2,000
Temp truck fuel	2 X $1,500	$ 3,000
Misc. equipment		$ 5,000
Total		$168,887

FY 2017-18 – FY 2018-19

Description	Unit cost	Sub total
Temporary personal services	14 technicians for 6 weeks	$ 59,555
Contract personal services	APHIS predator control	$ 50,000
Operating		
VITs	60 X $250	$ 15,000
Fixed-wing flights	48 hours X $314	$ 15,072
Rental trucks	3 X $3,300	$ 9,900
Rental truck tires	8 X $250	$ 2,000
Temp truck fuel	2 X $1,500	$ 3,000

Misc. equipment	$ 5,000
Total	$159,527

H. Related Federal Projects

This project will primarily occur on energy development company and BLM properties, including a small amount of private lands. The study does not involve formal collaboration with any federal agencies, other than contracting predator control efforts with WS, nor does the work duplicate any ongoing federal projects.

I. Literature Cited

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J. Tables and Figures

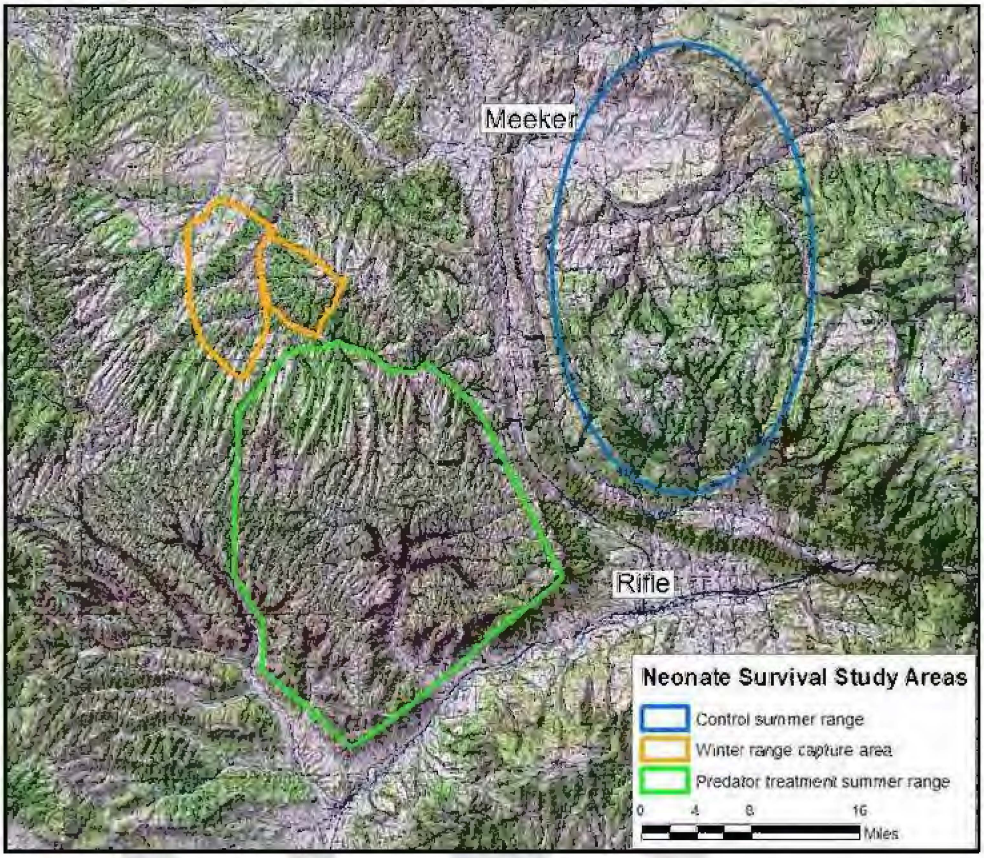

Figure 1. Mule deer winter and summer ranges, Piceance Basin, northwest Colorado. Pregnant adult females on winter range (orange boundary) will receive vaginal implant transmitters to facilitate neonate capture and collaring efforts in the predator treatment area (green boundary). Noenates in the control area (blue boundary) will be opportunistically captured to provide survival rate comparisons between summer ranges with and without focused predator reduction.

K. Appendices

Compliance

NEPA

NEPA requirements for this project are currently under review in an Environmental Assessment prepared by USDA Wildlife Services.

Endangered Species Act

The project work in this proposal does not include any ground disturbing activities and therefore will not disturb any sensitive plant species in the area. Trapping activities could influence medium to large mammal species. Sensitive mammal species in Colorado that could be influenced by trapping efforts include Canada lynx (*Lynx Canadensis*), wolverine (*Gulo gulo*), and gray wolf (*Canis lupus*). Potential occurrence of these species in the predator treatment study area is extremely low given that the area represents low quality lynx habitat and that no records of these species have been documented in this area in recent history. In the unlikely event that one of these species is caught during trapping efforts, the trapping methods employed are non-lethal and captured animals will be immediately released during daily trapping efforts.

Other Landscape-Oriented Federal Acts

This project will have no negative impact on the landscape, therefore it will not violate provisions of Federal Legislation governing floodplains, wetlands, historical sites, and prime and unique farmlands.

Americans With Disabilities Act

When hiring personnel as part of this project, qualified individuals will not be discriminated against based on disability. No structures or access points will be constructed as part of this research, and thus accessibility is not applicable.

Animal Welfare Act

Neonate captures in the predator treatment area have been addressed through an extension of CPW ACUC protocols 01-2012 below. Additional neonate capture and handling protocols for the control area and WS trapping and euthanasia protocols will be addressed through an addendum submitted to the CPW ACUC committee prior to project initiation.

COLORADO PARKS AND WILDLIFE ANIMAL CARE AND USE COMMITTEE (CPWACUC)
ADDENDUM TO ONGOING, APPROVED WILDLIFE RESEARCH PROJECTS

Note: This form may not be used for new wildlife research projects.

1. CPW ACUC File # 01-2012
2. Principal Investigator(s): Chuck Anderson Phone: 970-472-4335
3. Title of project: Effects of natural gas development disturbance on neonatal mule deer survival
4. Fiscal year of this project's initiation: 2012
5. List names of all new personnel associated with this project:
6. Are sample sizes or numbers of animals to be used the same as originally described with no substantive changes (i.e., 10% of original proposal)? If sample sizes or animal numbers are substantially greater or less than described in original study plan, provide a justification for this change.

   Maximum sample size will be reduced from 120 to 80 neonate captures annually due to reduction from 4 to 2 study areas. The 2 study areas removed proved to be too logistically difficult to maintain adequate sample sizes. This project will continue through 2018.

7. Is the animal component of the project the same as originally described with no substantive changes (e.g., anesthesia, analgesia, capture methods, euthanasia, species, surgical procedures, etc.)?

   Yes __X__ No _____, *If No, describe changes:*

8. Will the foregoing changes result in greater levels of pain, suffering, stress, discomfort, deprivation, etc., experienced by experimental animals than those originally described and approved?
   Yes ____ No _X_

   If answered yes, attach detailed justification and indicate here the date of search, source of literature search, date range searched, and key words an combination of key words searched to document the lack of alternative methods:

9. Will additional pain and suffering be controlled? Yes ____ No ____ N/A _X_
   If answered no, attach a detailed justification.

   If answered yes, attach a detailed description of how pain and suffering will be controlled.

10. If required, was the attending veterinarian consulted when planning these changes?
    Yes ____ No ____
11. Does the proposed project now include planned euthanasia of animals? Yes ____ No ____

Date: 5/25/2015 Signed: Chuck A. ______
Principal Investigator

Date: 5/___ ____ Signed: ________________
ACUC Attending Veterinarian

Date: 5/25/15 Signed: ________________

Appendix H. Colorado Parks and Wildlife Study Plan: Mule Deer Population Response to Cougar Population Manipulation.

PROGRAM NARRATIVE STUDY PLAN ADDENDUM
FOR MAMMALS RESEARCH
FY 20115-16

State of:	Colorado	:	Parks and Wildlife
Cost Center:	3430	:	Mammals Research
Work Package:		:	
Task No.		:	
		:	
Federal Aid Project No.			

Mule Deer Population Response to Cougar Population Manipulation

Principal Investigator
Mat Alldredge, Mammals Research, Colorado Parks and Wildlife
Brian Dreher, SE Region Senior Biologist, Colorado Parks and Wildlife

Cooperators
Chuck Anderson, Mammals Research Leader, Colorado Parks and Wildlife

STUDY PLAN:

STUDY PLAN APPROVAL

Prepared by:	Mat Alldredge	Date:	August 22, 2016
Submitted by:	Mat Alldredge	Date:	
Reviewed by:		Date:	
		Date:	
		Date:	
Biometrician:		Date:	

Mule Deer Population Response to Cougar Population Manipulation

A. NEED

The recently adopted Colorado mule deer strategy identifies predation as one of the potential factors limiting Colorado mule deer populations. Since the adoption of the mule deer strategy by the Parks and Wildlife Commission, members of the Leadership Team developed a plan for the implementation of the strategy. As part of the implementation strategy, staff examined existing predator and deer research and monitoring data to identify areas where predation may be most limiting to mule deer, which in turn could be used to inform predator harvest/management decisions. In June 2015, CPW personnel from the SE Region, Terrestrial, and Research branches met to explore the concept for a project that examines how deer demographic parameters may change following cougar suppression.

Deer data analysis unit (DAU) D-16 is comprised of game management units (GMUs) 49, 57, 58 and 581 which are located on the north side of the Arkansas River between the towns of Leadville and Canon City (Figure 1). Beginning in 1999, D-16 was added as one of 5 intensive deer monitoring DAUs in the state. Under the intensive monitoring protocol, we typically monitor 80-90 radio collared adult does to determine annual survival rates and 60 radio collared fawns annually to determine over winter fawn survival rates. Since 1999, we have radio collared 1,086 adult does and 898 fawns in D-16 to examine annual adult survival and winter fawn mortality.

From 1999-2014 , averaging across all years, the leading known cause of both doe (6.4%) and fawn (7.5%) mortality has been cougar predation (Figure 3, 4 and Table 1, 2). Cougar predation has ranged from 0 to 60% (avg. 28%) of the total mortality for does and 0 to 64% (avg. 32%) of the total mortality for fawns (Calculated from table 1,2). Currently, the mule deer population in D-16 is (11,247) below the long-term population objective of 16,000-20,000 deer. Based on survival data from 1999-2014, deer population growth in D-16 might partially be limited by cougar predation on fawns and adult does (Figure 3 and 4).

Predation on mule deer is often identified as one of the potential reasons that populations are below the long-term objectives (Colorado West Slope Mule Deer Strategy http://cpw.state.co.us/Documents/MuleDeer/MuleDeerStrategy.pdf, Ballard et al. 2001). In D-16, the adult survival data and relatively high predation rates from 2008-2012 (Table 1) suggests that cougar predation could be contributing to this lower than objective mule deer population.

Overwinter fawn survival has shown similar patterns to annual doe survival ranging between 59.2% and 86.2% (Table 2). Since 2013, overwinter fawn survival has been near 80% (Table 2). However, early winter fawn:doe ratios in D-16 have averaged 54.7 fawns per 100 does (range 38.5 to 68.0) since 1995 (CPW, unpublished data). Assuming fetal rates for adult (≥ 2 years old) mule deer of 1.8 (Bishop et al. 2008), it would appear neonate survival is a bigger issue for population growth and recruitment than other demographic rates, unless doe survival drops below 80%. Using the above fetal rate (1.8), early winter fawn:doe ratio (54.7), and overwinter survival of 80%, survival to age one for mule deer would be 24.3%.

The success of a project to control predators to increase a population of mule deer is dependent upon the deer population in relation to the habitat carrying capacity (Ballard et al. 2001). If the population is at, or surpassed the habitat carrying capacity, it is likely that increases in survival rates caused by predator control will be compensated by other factors of mortality, such as malnutrition (Bartman et al. 1992). Conversely, if the population is below the habitat carrying capacity, reduction in mortality caused by predation could provide an additive response to increase survival rates of a mule deer population (Bleich and Taylor 1998; Hurley et al. 2004).

Examination of the malnutrition rates of fawns in D-16 can give some indication about whether a given population is at or exceeds carrying capacity. Since 1999, the highest rate of malnutrition was observed in 2004, when 5 of 57 (9%) fawns died from malnutrition causes (Table 2). Bartman et al. (1992) observed significantly higher rates of malnutrition in a NW Colorado mule deer herd, in which they documented reductions in predation rates being compensated by higher rates of malnutrition. The relatively low rates of malnutrition (1.6%) observed since 1999 suggests that the current population is below carrying capacity and limiting factors, such as predation, may be restricting mule deer population growth in D-16.

In order to assess the effect of management manipulations it is necessary to do this in an experimental framework with a control and treatment study area, otherwise the magnitude of the effect will be unknown as other limiting factors fluctuate. D-34 (GMUs 69, 691, 84, 86, and 861) is an adjacent mule deer DAU to the south of D-16, which has a similar mule deer population size (10,468) and habitat. Surveys (winter flights) also suggest that demographic rates are similar in terms of population ratios (45.2 fawns per 100 does based on 5 year average). Using D-16 and D-34 in a crossover design will allow for the manipulation of a potential limiting factor for mule deer population growth or survival and examining similarities in the response as the control and treatment is switched between the areas.

A research project will be conducted, beginning in the winter of 2016/2017, to examine the mule deer population response to cougar suppression. The study will be conducted in D-16 and the adjacent DAU, D-34. A crossover design will be used to examine the effects of cougar suppression in three stages. In stage one (years 1-3), cougar populations in D-16 will be suppressed (50% of population potential), while cougar populations in D-34 will be allowed to increase towards habitat potential with light harvest(10% harvest). Stage 2 (years 4-6) represents a recovery stage where both populations will be allowed to increase towards habitat potential (10% harvest). The final stage (years 7-9) represents the crossover where D-34 cougar populations will be suppressed (50% of population potential), while D-16 will continue to be allowed to increase towards habitat potential with light harvest (10% harvest).

The impact of cougar hunting on cougar populations, especially high levels designed to suppress populations, can be varied and is not well understood. Anderson and Lindzey (2005) demonstrated that a Wyoming cougar population could be significantly suppressed through 2 years of heavy harvest. Harvest rates of approximately 15% of the population have generally been shown as the tipping point between maintaining stable populations and decreasing populations. However, the percent adult female harvest is the crucial factor in population change.

The direct effect of harvest on population size is fairly clear but more subtle impacts on other demographic parameters is less clear, primarily due to a lack of information on these parameters. Cougars are inherently difficult to study because of their reclusive nature, small population sizes and large movement patterns. Technological advances, such as GPS collars, are only now allowing for the detailed study of cougars to understand these more subtle impacts. Past research has been limited by small sample sizes and case studies of a few events observed during the course of monitoring studies.

Harvest structure can be a useful tool for monitoring and managing cougar populations (Anderson and Lindzey 2005). Because the sex and age classes of cougars exhibit different behaviors and movement patterns (Barnhurst 1986) they also tend to differ in their vulnerability to harvest. The management experiment being conducted provides a unique opportunity to more completely develop our understanding of the relationship between harvest structure and cougar population structure. Understanding this relationship as populations are manipulated throughout the management experiment will provide critical information for management in the future as decisions are made about suppressing, stable or increasing cougar populations.

In addition to furthering CPW's understanding of harvest structure, this management experiment will provide us a significant amount of information on population level responses to various harvest strategies within a crossover design. Several studies have examined the impacts of harvest on cougar populations (Anderson and Lindzey 2005, Cooley et al. 2009, Ruth et al. 2011, Wielgus et al. 2013, Maletzke et al. 2014, Logan 2015), however no study that we are aware of has examined the impact of hunting at these two ranges in harvest level within a controlled crossover design. Such detail should allow for detailed data during decreasing and increasing phases of the population across the two study areas.

Density-dependent population regulation has a rich history and provides much of the basis for sustainable hunting and game management (Caughley 1977, Caughley and Sinclair 1994, Strickland et al. 1994). Compensatory mortality would predict that harvest mortality would be offset by density-dependent responses in reproduction, cub survival, and female population growth if harvest is primarily males because of reduced competition for resources. However, Wielgus et al. (2013) suggest that harvest of male cougars is not compensatory but is additive or possibly even depensatory.

One aspect of this study will be to closely examine cause specific mortality and develop a thorough understanding of levels of mortality in relation to population size and hunting pressure. Previous studies have suggested that male survival is lower in hunted populations (Lambert el al. 2006, Robinson et al. 2008, Ruth et al. 2011) but that female survival is lower in non-hunted populations (Logan and Sweanor 2001). Part of this is due to hunter selectivity on males but under situations of heavy harvest selectivity may decrease (Anderson and Lindzey 2005). The progression of the management experiment will directly allow us to measure cause specific survival during declining and increasing phases of a cougar population and under heavy and light harvest scenarios. This will allow a clear examination of non-hunting mortality rates, such as disease, intra-specific strife, or other natural mortality.

Similarly, cause specific survival of kittens throughout the stages of the project will provide essential information for management as this directly relates to population growth and recovery. Past research has suggested that increased harvest has actually led to decreased kitten survival because of infanticide (Cooley et al. 2009, Ruth et al. 2011). Increased infanticide has been suggested to relate to high male harvest as this leads to an increase in subadult males in the population and territorial instability (Logan and Sweanor 2010, Ruth et al. 2011). However, recent cougar research in Colorado have shown higher infanticide rates during a 5 year non-hunting period than the subsequent 5 year hunting phase of the study (Logan 2015).

Other aspects of cougar population growth are reproductive rates and immigration/emigration rates. Theory behind density-dependent relationships would suggest that reproductive rates would increase during scenarios of increased harvest. Increased male immigration has been documented as a result of increased harvest levels (Cooley et al. 2009, Wielgus et al. 2013). Almost all males disperse, regardless of cougar density, with typical dispersal distances of 85 to 100 km (Sweanor et al. 2000). However, 50 to 80% of females remain in their natal range, establishing overlapping home-ranges with other breeding females (Sweanor et al. 2000). In a recent cougar study in the Front-Range of Colorado, a significant portion of subadult males did not disperse (Alldredge, unpublished data). It is unclear how various levels of harvest will impact immigration/emigration rates and the potential impact that this could have on reproductive rates. Wielgus et al. (2013) suggest that increased immigration actually decreased female reproductive success.

There is also the perception that high immigration rates of subadult males will lead to increases in human conflict and livestock depredation. Some studies have indicated that harvest and subsequent increases in subadult males have correlated with human-cougar conflict (Peebles et al. 2013, Maletzke et al. 2014). However, Kertson et al. (2013), suggest that demographic class did not relate to human-cougar interaction. This management experiment will provide direct information on human-cougar interactions with respect to changes in cougar populations, age structure, and immigration rates.

Cougar hunting has also been linked to changes in movement patterns, home-range size and diet composition. Keehner et al. (2015) suggested that female cougars will switch primary prey in an attempt to avoid conflict with male cougars in a hunted population. Increased hunting pressure was also suggested to increase home-range size and overlap in Washington (Maletzke et al. 2014) suggesting increased intraspecific conflict. Avoidance behaviors, increased space use and changes in movement patterns could all impact energetic demands of cougars, which could then alter foraging behavior.

Estimating cougar population size or density is also very useful for management purposes but has proven to be difficult and expensive to do. Historically mark-recapture techniques have been used, which require the physical capture and handling of animals and is therefore expensive. More recently developments have been made for noninvasive genetic sampling of cougars to get population estimates using scat detection dogs or hair snags. Alldredge (unpublished data) has been developing the hair snag approach and it is showing promising results. In a hunting situation, especially when reporting is mandatory, harvest data can be used to supplement these data in statistical population reconstruction models (Fieberg et al. 2010, Skalski et al. 2012, Gast et al. 2013). Through this management experiment both hair snag and harvest data will be available to test these procedures and develop techniques to obtain better population densities statewide. GPS collared cougars will provide baseline data for assessing potential bias in estimates.

B. OBJECTIVES

The primary objectives of this study are to examine the effects of cougar predation on mule deer demographic parameters in order to develop a better understanding of how cougar management strategies can impact deer management. These objectives are to evaluate the effects of cougar population size on mule deer demographic parameters and to evaluate the effectiveness of sport hunting to achieve high rates of cougar harvest. As part of this we will need to determine cougar density estimates both pre and post suppression periods.

In addition to the primary objectives we also intend to develop a better understanding of cougar harvest structure and population responses to varied levels of harvest. Age/sex structure of the harvest will be examined relative to cougar density and harvest levels in order to inform future management of the relationship between cougar population demographics and harvest. Harvest information will also be used to estimate population density through statistical population reconstruction. Cougar demographic rates (cause specific mortality, reproduction, immigration/emigration) will be estimated relative to population density and harvest level. In addition to this movement patterns, nuisance behavior and diet composition will be monitored in relation to density and harvest pressure.

C. EXPECTED RESULTS OR BENEFITS

Predator control is often raised as a management option to attain management goals for prey populations. Past research has not produced definitive results, especially at large scales. This study is designed to directly assess management strategies is a predator-prey system and the feasibility of such strategies. The primary results and benefits are:

1. Determining our ability to manipulate cougar populations through harvest.
2. Examining the effects on mule deer population demographics relative to changes in cougar density.

Cougar hunting is an ever increasingly contentious issue among our stakeholders. Unfortunately information on the subject is depauperate, conflicting, or based on small sample size. This study is designed to address some of the specific concerns raised about hunting and provide managers with tools to evaluate the success of future management strategies.

1.) Harvest information that can be utilized for future management of cougars.
    a. Evaluation of harvest structure relative to cougar population density and harvest levels during decreasing and increasing phases.
    b. Examination of population recovery after heavy harvest.
2.) Demographic information on cougar populations relative to cougar density and harvest regime.
    a. Density-dependence of cougar harvest.
    b. Cause specific mortality of adults and subadults.
    c. Cause specific mortality of kittens, including infanticide rates.
    d. Reproductive rates.
    e. Immigration/emigration rates.
    f. Movement patterns.
    g. Diet composition.
    h. Nuisance behavior.
3.) Further refinement of population estimation techniques.
    a. Statistical population reconstruction based on hair snag and harvest data.

D. APPROACH

Cougar Suppression

Both D-16 and D-34 have cougar hunt codes that are inclusive of all the GMUs within the DAU. Beginning in 2017, we will initiate suppression in D-16 for a 3 year period to suppress lion populations in the GMUs included in D-16. To suppress cougars we would increase lion harvest to a level which will have a significant impact on the density of cougars in the DAU (harvest rate of approximately 50% of the potential population). In years 1-6, D-34 would serve as the unsupressed cougar population for this experiment, where harvest quotas would be set to 3 lions per 1,000 km^2. It is expected that this rate of removal will reflect a reduction in the historic quota in D-34 and would result in an increasing cougar population. In years 4-9 harvest quotas would be decreased in D-16 to 3 cougars per 1,000 km^2 in order to allow the population to recover to a high level by year 7. In years 7-9, we would suppress lion populations in D-34 similarly too years 1-3 in D-16. If suppression levels are not reached by hunter harvest other approaches will be considered to reduce population densities. Other approaches may include using USDA Wildlife Services (using hounds, cage traps, and snares to capture cougars) or contracting with cougar hunters using hounds to increase removal efforts in the area to reach necessary removal levels. If these other approaches are utilized all meat and hides will be donated. Over the course of the study, we will examine the effects of cougar population density on mule deer demographic parameters using the crossover in cougar harvest in D-16 and D-34.

Deer DAU	Total Area km^2	Lion Habitat km^2	Potential Population	Suppressed Quota	Unsuppressed Quota
D16	6,138	4,096	123	61	12
D34	6,536	4,913	147	73	15

Cougar Monitoring

Recently, CPWs Mammals Research Section developed a sampling methodology and protocol for estimating cougar densities non-invasively through the collection of hair samples at hair snags (Yeager 2016, Alldredge unpublished data). Hair samples are genetically analyzed and the DNA profile of each cougar is used to develop a mark-recapture population estimate. We will use this methodology to estimate cougar abundance for both D-16 and D-34 throughout the study. Sampling will be conducted in year 3, 6 and 8 to capture the high and low population sizes. Monitoring in D-34 will occur in years 2, 7 and 9 to match up with the changes in harvest to capture the high and low population sizes as well. We can use this information to examine changes in cougar populations and also changes in sex and age class structure of the population both pre and post-harvest treatment. High lion harvest rates will be required to successfully reduce the population and it will be important to know if standard harvest management is successful in achieving this objective. An added benefit of monitoring the lion population under a suppression management objective would be evaluation of this approach for statewide lion management application.

A typical grid cell size used for population surveys is one that is equal to a quarter of the average home-range size for the species of interest (Otis et al. 1978, White et al. 1982, Williams et al. 2002). The average home-range size for female cougars on the Front-Range is about 100 km^2 (Alldredge, unpublished data), so we will use a 5 km by 5 km grid cell size as our primary grid (Figure 5). A 1 km by 1 km grid will be overlaid within the primary grid and one of these smaller cells will be randomly selected within each primary grid. Within each selected cell, specific sites will be selected based on likely areas to attract a cougar, property access, and field logistics. Given the size of the area every other primary grid cell will be sampled in a checker board pattern (67 cells), and additional cells will be incorporated if logistically feasible.

There will be 3 main sampling periods during the study, each 4 weeks in duration. During sampling, sites will have a call, a camera (if possible), a scent, a visual lure and 1 to 2 hair snaring devices. All sites will be checked at approximately weekly intervals for signs of visitation and hair, and batteries will be checked in cameras and calls.

All sites will be similar in design, containing the same elements. The primary attractant will be a predator call (fawn or rabbit distress) programmed to play a 5 to 10 second distress call 30 second intervals. These calls are also equipped with light sensors rendering them inactive during daylight hours. These calls also have a motion sensor so they play quieter when an animal is detected and a motion device is activated within the cubby to provide a moving visual stimulus. We will cable the calls <1 m up from the base of a tree. We will then build a perimeter around the tree with thick brush leaving obvious entry ways to the call and bait. We will configure lines of barbed wire (vertical or horizontal) within the entrance. Terrain and vegetation features will determine the height of the wire and consequently whether we desire a cougar to step over, under, or through 2 strands. A sticky roller will also be used as a secondary hair snag at each site. Additional hair snag devices may be tested where a target animal has to reach for bait over a hair snag. At each site, we will position an infrared motion-sensor camera (Reconyx® PC85 Rapidfire® or PC800 Hyperfire®) set to rapidly take 5 photos when triggered.

To minimize the possibility of sample contamination (multiple animals leaving hair) and degradation, we will check the sites for activity every week. We will consider hair on a single barb as one sample and denote quantity with a score of 1 – 3 (1 equals < 5 hairs, 2 equals 6 – 15 hairs, and 3 equals > 15 hairs). We will remove hair using sterile tweezers and re-sterilize the barb by passing a flame under it (Kendall et al. 2008, Settlage et al. 2008). We will place the hair in a small paper envelope. Paper envelopes will then be put in a plastic bag with a desiccant and stored at room temperature (Taberlet and Luikart 1999).

If hair is on the sticky rollers the entire roller will be collected, wrapped in wax paper and placed in a plastic bag.

We will tally detections as one per night per cougar based on photographic confirmation. Dependent kittens will not be counted. Though we expect all animals visiting the sites to be detected by camera, hair samples may also provide proof of cougar presence as well as identifying unmarked animals.

Hair samples will be processed at the USGS Fort Collins Science Center, FORT Molecular Ecology Lab. Taberlet et al. (1996) suggested that to achieve a correct genotype at a 99% confidence level, 8 U template DNA is needed (1 U is equivalent to the DNA content of 1 diploid cell). Therefore when possible, we will extract DNA from 10 hairs (Goossens et al. 1998, Boersen et al. 2003) using Qiagen DNeasy® Tissue Kits (Qiagen Inc., Valencia, CA). Samples will be genotyped using 9 – 12 microsatellite primers shown to have high variability in cougars (Ernest et al. 2000, Sinclair et al. 2001, Anderson et al. 2004). We will amplify the DNA by polymerase chain reaction (PCR) using a M13-tailed forward primer as described by Boutin-Ganache et al. (2001). Each locus will be analyzed via GeneMapper®.

Teeth from harvested cougars are also routinely collected in order to obtain the age structure of the harvested population. DNA will be extracted from teeth collected in D-16 and D-34 and genotyped following a similar procedure. This information may be incorporated into population estimates, although, if hunters are selective this may bias estimates. Potentially, within gender, the bias will not exist.

Capture-recapture models (Williams et al. 2002) will be used to estimate population size or density. A robust design framework (Kendall 1999) will be used initially to assess temporary emigration. Given the sampling design we will also be able to use spatially explicit capture-recapture models if multiple detections are made at multiple locations (Borchers and Efford 2008, Royle et al. 2009) or models that incorporate auxiliary telemetry data (Ivan et al. 2013) that provide information on the effective area sampled. Estimates will be compared across years for consistency.

Given the collaring effort that will be made during the study it will also be possible to use mark-recapture techniques to estimate populations, which would allow for an assessment of the genetic technique. Harvest data will also provide the opportunity to combine data sets and use statistical population reconstruction (Fieberg et al. 2010, Skalski et al. 2012, Gast et al. 2013). Combining these approaches should provide more robust estimates of cougar density. The development of these reconstruction models should also allow for better estimation of cougar densities across the state.

Monitoring Mule Deer Population Demographics

Since 1999, we have been monitoring a sample size of approximately 80 adult does in D-16 to examine annual deer survival. We have also collared 60 fawns annually to examine over-winter fawn mortality. For this project, we will maintain a similar sample size in D-16. In addition, we will capture (see appendix I for approved capture and handling guidelines) and monitor a sample size of 80 adult does and 60 fawns annually in D-34 to examine cause-specific adult doe annual survival and over-winter fawn survival. In both D-16 and D-34 we will conduct aerial surveys in the month of December annually to examine post-hunt fawn:doe:buck ratios. These values will be used to examine any potential changes in population performance as a result of this management experiment. Expectations are that doe survival in the heavily harvested area will maintain at or near 90%, while doe survival in the lightly harvested area will be lower, if predation is an additive factor.

December fawn:doe ratios and cause specific mortality are likely to be more sensitive parameters to examine in relation to differences in cougar harvest. It would appear that fawn mortality from birth up to

December is significant, as discussed above, and, if this is in part due to cougar predation on neonatal fawns, a difference should appear in December fawn:doe ratios between the two study areas.

We will also use a competing risks model (Heisey and Patterson 2006) to examine cause specific mortality rates. This will allow us to directly estimate mortality due to cougar predation and compare between years and study areas to determine if cougar harvest levels are influencing this mortality vector. Cougar population estimates may also be used in these models as covariates to examine the effect size of the cougar population on potential deer mortality.

Additional Considerations for Mule Deer Monitoring

As discussed previously, December fawn:doe ratios suggest a considerable amount of mortality occurring in neonates and much lower levels of mortality for over-winter fawn survival. Addressing cause specific neonatal mortality within the current study design may greatly improve our understanding of factors driving this population and why it is currently under objective. This will involve capturing adult does and fitting them with VITs, and subsequently capturing neonates following parturition and fitting them with expandable fawn collars to examine mortality sources from birth to age 1.

Capture and Handling of Cougars for Monitoring

In order to have sufficient power to detect changes in demographic parameters we need a large sample size. For example, current deer monitoring in Colorado use samples sizes of at least 50 does to detect changes in annual survival. In comparison, for D-16 and D-34 during the heavy harvest phase of the study we expect cougar population size to be 61 and 74 individuals, respectively. Because cougars exist at very low densities the majority of the population will have to be monitored during the heavy harvest phases of the study and a similar sample size will be maintained throughout.

Estimating infanticide rates relative to harvest levels is one of the key objectives of the study and likely the most difficult. Past studies have recorded a few cases of infanticide but generally not sufficient to calculate rates or compare differences. Because of this we will attempt to maintain a minimum of 20 collared adult females in each study area. Assuming birth intervals of 18 months, sample size of litters at risk will still be low over the course of the study. Kittens will be collared in all litters detected. Collaring adult and subadult males will also be important as these animals represent the mortality vector and it will be important to determine if infanticide is related to the age of the male. Such intensive collaring efforts should be sufficient to address the other objectives of the study, such as movement patterns and immigration/emigration rates.

Capture efforts for marking cougars will be conducted year-round, with the primary effort occurring between November and April. Capture with dogs and cage traps will be the primary methods for capturing adult and subadult cougars for radio collaring, but foot-hold snares and free-range darting may also be used if dogs or cage traps are not feasible. Capture of young kittens for fitting with expandable radio collars will be done by hand. Capture efforts for this part of the study are for marking individuals and collecting biological data, and not related to cougar suppression. A detailed description of CPW approved capture methods and handling procedures is provided (Appendix I).

Cougars will be ear-tagged in each ear with uniquely identifiable numbers marked with the withdrawal date, and a genetic sample collected using a 6 mm biopsy punch from each ear. A blood sample (approximately 6 ml) will be collected and archived for future use. All cougars will also be PIT tagged for individual identification by injecting a PIT tag in the back of the neck between the ears. Sex, approximate age from tooth wear, weight and morphometric measurements will be recorded. Vital signs will also be monitored during handling of cougars.

Adults, subadult females (over 1 year old) and subadult males (over 2 years old), will be fitted with satellite GPS collars equipped with proximity sensors. Subadult males estimated to be less than 2 years old will be fitted with expandable GPS collars equipped with proximity sensors because their neck size is still increasing at this age.

Den sites will be identified from clustering of GPS locations of the female. Once identified dens will be investigated to determine the number of kittens in each litter. Kittens will be collared using expandable VHF collars equipped with proximity sensors following procedures outlined in CPW approved capture and handling procedures (Appendix I). The proximity sensors found on all marked animals will allow for an assessment of interactions among individuals, especially in relation to the kittens. Proximity sensors on kitten collars will allow for an assessment of how much time the mother is with the kittens and will immediately send an alert when an unrelated individual comes in close contact with the kittens.

Harvest Structure of Cougars
It is mandatory in Colorado to check all harvested cougars. Age and sex structure of the harvest will be obtained through this mandatory check process. The relationship of the age and sex structure of the harvest will then be examined relative to cougar density, harvest regime and time since implementation of the harvest regime. A model will then be developed based on the harvest structure to predict current population characteristics. This will work in conjunction with the population reconstruction model.

Genetic samples will also be collected from all harvested cougars in the study area and surrounding DAUs by extracting DNA from the tooth collected for aging. These samples will be genotyped and analyzed for genetic relatedness within the study areas. We will also use genotype information to examine immigration/emigration at a larger extent. The specifics of this are not yet known but may actually require examining viral DNA to understand dispersal and source areas.

Demographic Rates of Cougars
We will use Bayesian statistical inference to estimate the cumulative incidence or cause-specific mortality function for adults, subadults and kittens (Heisey and Patterson 2006, Heisey 2009). Population density and harvest regime will be used as covariates in the model to determine if these factors have significant effects on cause specific mortality rates. Other factors that will be included are study area, time of year, landscape features, and human density. Density-dependence will be assessed with regard to levels of hunter harvest.

GPS data will be used to assess immigration/emigration rates between the two adjacent study areas. GPS data will also be used to evaluate dispersal patterns and distances. This will also be evaluated with respect to cougar density and harvest pressure. Genetic assessment of subadult males over a broader geographic area will be used to investigate the general dispersal patterns over a larger area that is more representative of typical dispersal distances.

Movement models will be used to assess landscape level factors that are driving the movement patterns of cougars on the landscape (Hanks et al. 2015). These movement patterns will be compared among harvest strategies and population densities to determine impacts of social structure and hunting pressure. Movement models will also include comparisons of individual cougars to determine if avoidance or spatial segregation occurs as population structures change in response to harvest. Female movement patterns will also be examined relative to live stage to determine the effects that kittens have on movement patterns and energetic demands.

E. Location

This work will be conducted in deer Data Analysis Units (DAU) D-16 and D-34 (Figures 1 and 2), located in the foothills and mountainous regions of south-east Colorado. D-16 consists of the Buffalo Peaks game management units (GMU) 49, 57, and 58, and one of the Cripple Creek/Pikes Peak GMU 581. Elevations in D16 range from 5,250 feet to 14,200 feet characterized by valley bottoms and canyons rising up to steep mountains. Vegetation ranges from grass/shrub communities and pinon/juniper and lower elevations and includes aspen, pine, and spruce/fir as elevations increase up to alpine communities. Public land in these units ranges from 35% to 80% of the area. Total area of D-16 is 6,138 km^2 with approximately 4,096 km^2 considered potential cougar habitat, with a potential population of 123 cougars.

D-34 consists of the Wet Mountains/Sangre De Cristo GMUs 69, 691, 84, 86, and 861. Elevations range from 5,168 feet to 14,064 feet characterized by prairie, foothill, rocky canyons at lower elevations and rising up to steep mountainous terrain. Vegetation ranges from short grass prairie, pinon/juniper, shrub communities at low elevations and includes aspen, pine and spruce/fir as elevations increase to alpine communities at higher elevations. Public land ranges between 30% to 70% of the area in these units. Total area of D-34 is 6,536 km^2 with approximately 4,913 km^2 considered potential cougar habitat, with a potential population of 147 cougars.

H. Related Federal Projects

Our research will be conducted on federal (i.e., BLM, USFS), state and private lands. The study does not duplicate any ongoing federal projects.

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J. Tables and Figures

Table 1: Doe mortality in D16, 1999-2014

Year	N	Mort N	Survived	Coyote	Mtn Lion	Other/Ukn Pred	Road Kill	Other	Malnutrition	Harvest	UKN	Survival
1999	49	6	43	0	0	1	0	0	0	0	5	87.8%
2000	47	7	40	0	0	0	0	2	0	0	5	85.1%
2001	40	12	28	0	3	5	1	2	1	0	0	70.0%
2002	43	13	30	0	1	0	2	1	1	0	8	69.8%
2003	47	14	33	0	1	0	3	0	1	0	9	70.2%
2004	62	11	51	0	3	0	1	0	0	0	7	82.3%
2005	61	4	57	0	1	0	0	0	0	0	3	93.4%
2006	69	10	59	0	6	1	0	0	0	0	3	85.5%
2007	80	13	67	3	3	1	0	0	3	0	3	83.8%
2008	80	20	60	3	9	0	0	0	3	0	5	75.0%
2009	83	24	59	3	6	1	6	0	1	0	7	71.1%
2010	83	20	63	1	9	1	1	0	1	0	7	75.9%
2011	92	20	72	3	6	0	4	0	0	0	7	78.3%
2012	90	24	66	3	14	0	3	0	0	1	3	73.3%
2013	81	11	70	2	5	0	0	0	1	0	3	86.4%
2014	79	9	70	1	2	0	1	1	0	1	3	88.6%
Total	1086	218	868	19	69	10	22	6	12	2	78	
%	100%	20.1%	79.9%	1.7%	6.4%	0.9%	2.0%	0.6%	1.1%	0.2%	7.2%	

Table 2: Fawn mortality in D16, 1999-2014

Year	N	Mort N	Survived	Coyote	Mtn Lion	Ukn Pred	Road Kill	Other	Malnutrition	Harvest	UKN	Survival
1999	53	18	35	0	0	0	2	0	0	0	16	66.0%
2000	49	20	29	0	5	2	0	0	1	0	12	59.2%
2001	46	11	35	1	7	2	1	0	0	0	0	76.1%
2002	43	8	35	1	1	0	2	0	0	0	4	81.4%
2003	60	9	51	0	2	0	1	2	0	0	4	85.0%
2004	57	10	47	1	2	0	1	0	5	0	1	82.5%
2005	57	9	48	2	3	0	0	1	1	0	2	84.2%
2006	57	10	46	1	4	1	0	0	1	0	3	80.7%
2007	58	8	50	1	2	0	0	1	3	0	1	86.2%
2008	60	19	41	3	5	1	0	0	0	0	10	68.3%
2009	58	22	36	5	8	0	1	0	0	0	8	62.1%
2010	63	12	51	2	7	0	0	0	0	0	3	81.0%
2011	61	16	45	4	6	0	1	0	0	0	5	73.8%
2012	57	19	38	8	6	0	0	0	0	0	5	66.7%
2013	58	12	46	2	5	0	0	0	2	0	3	79.3%
2014	61	13	48	3	4	0	1	0	1	0	4	78.7%
Total	898	216	681	34	67	6	10	4	14	0	81	
%	100%	24.1%	75.8%	3.8%	7.5%	0.7%	1.1%	0.4%	1.6%	0.0%	9.0%	

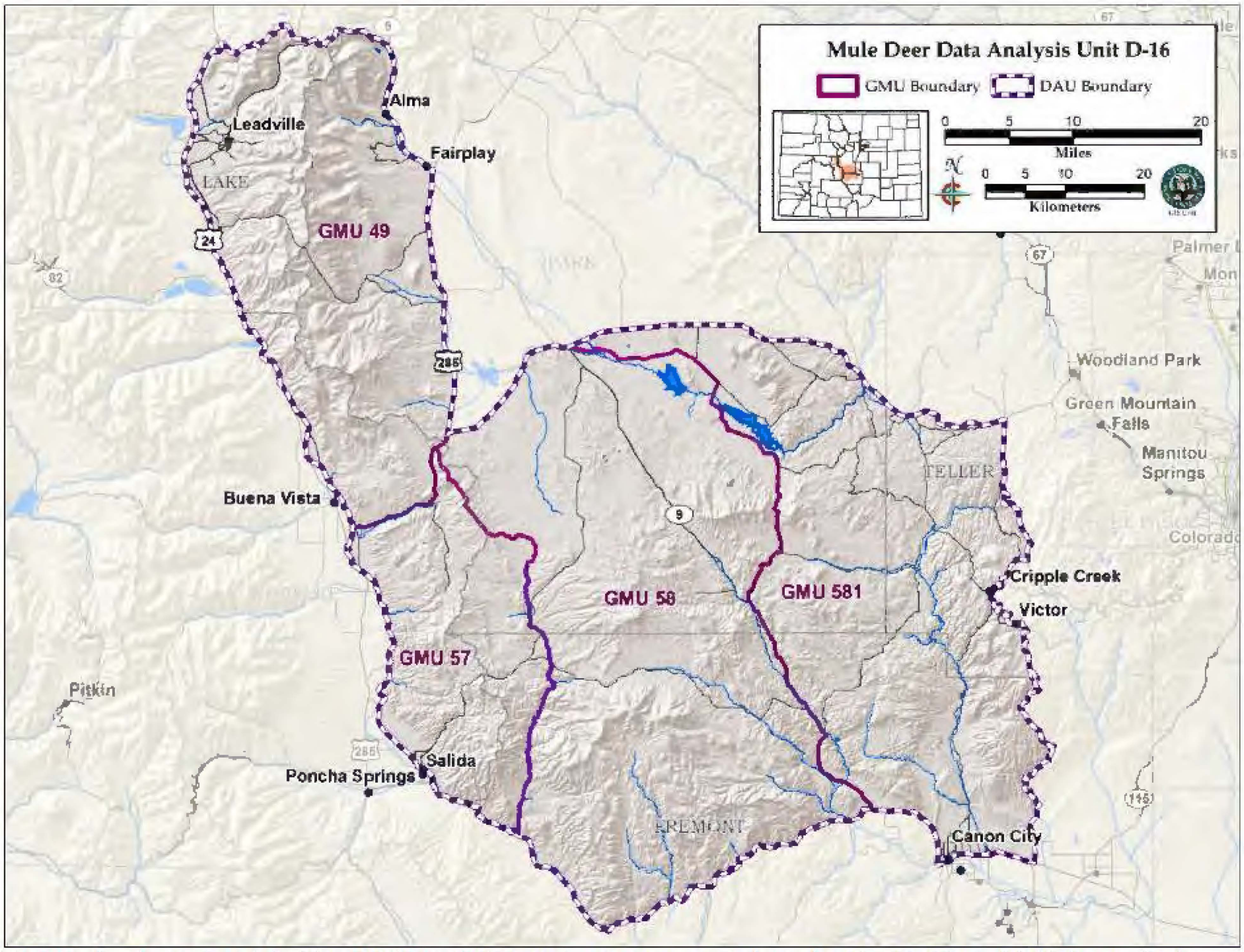

Figure 1. Deer DAU D-16, which includes game management units 49, 57, 58 and 581 in central Colorado

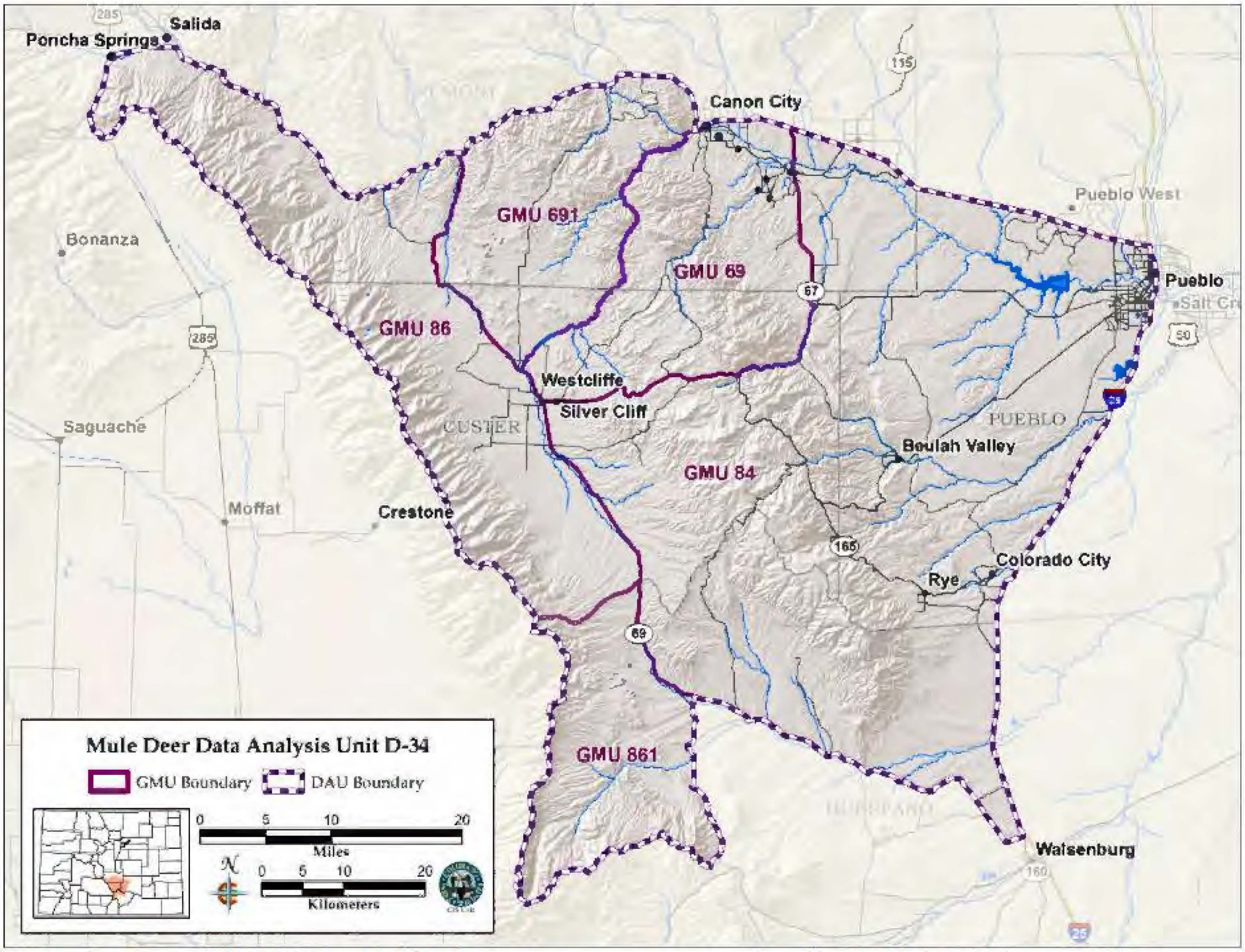

Figure 2. Deer DAU D-34, which includes game management units 69, 84, 86, 691, and 861 in central Colorado

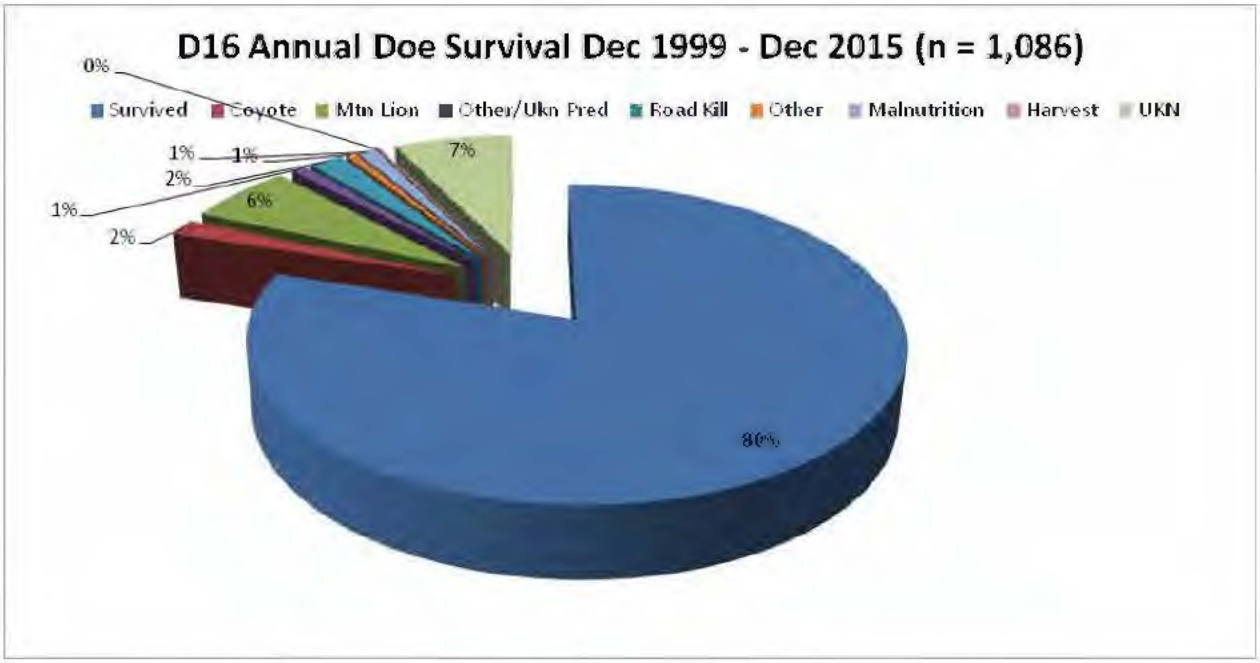

Figure 3. Annual doe survival and cause specific mortality for mule deer in D-16 from 1999-2015

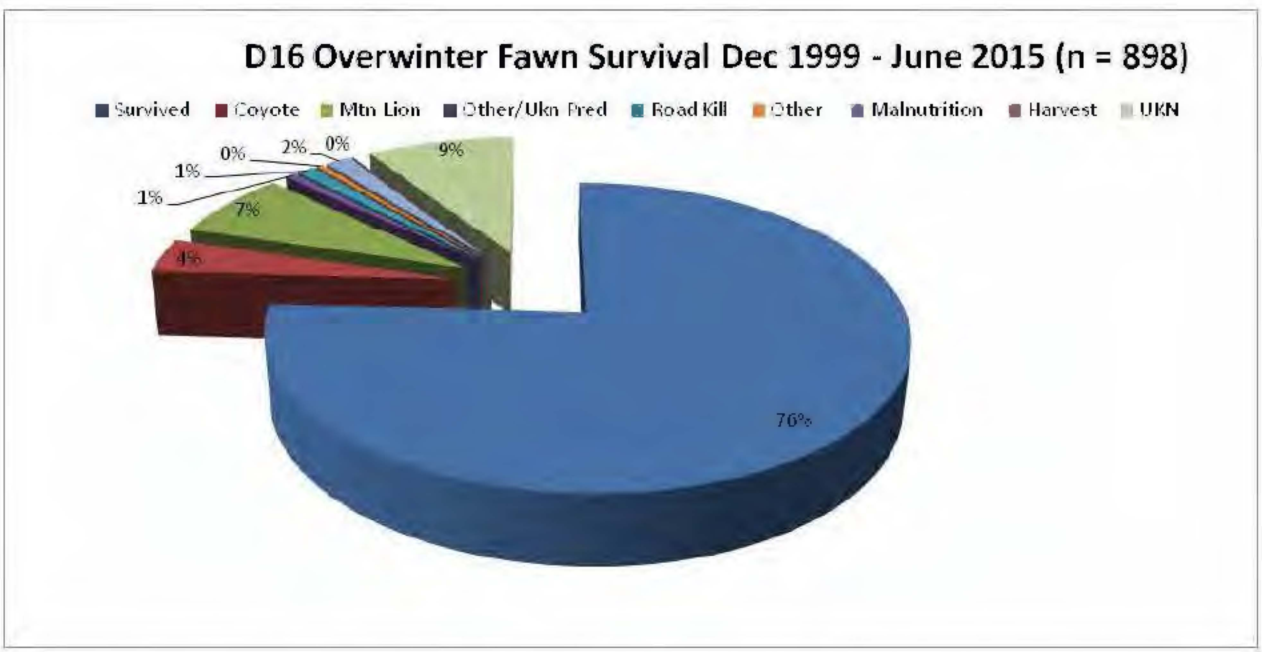

Figure 4. Overwinter fawn survival and cause specific mortality for mule deer in D-16 from 1999-2015.

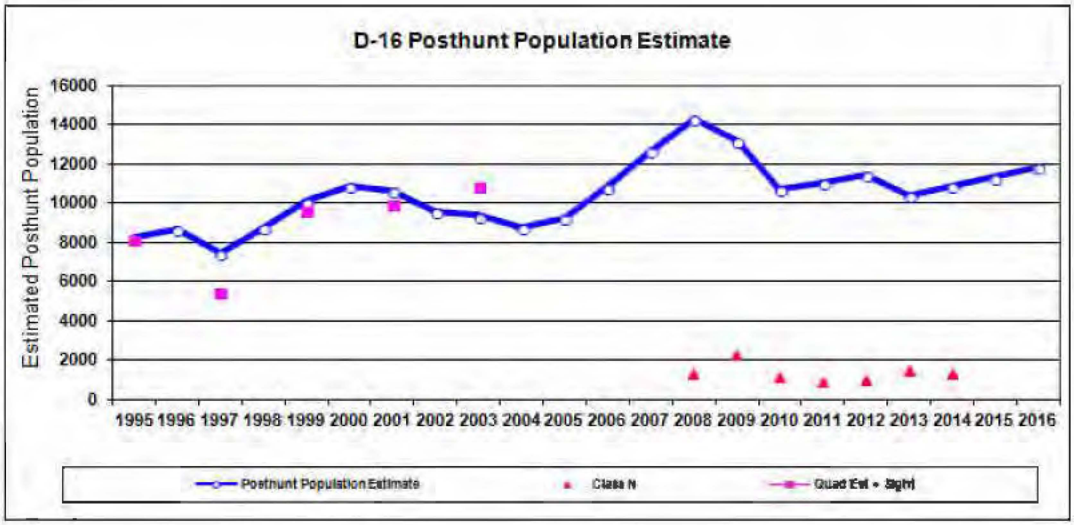

Figure 5. D-16 post deer hunt population estimate from 1995-2014 derived from a population model

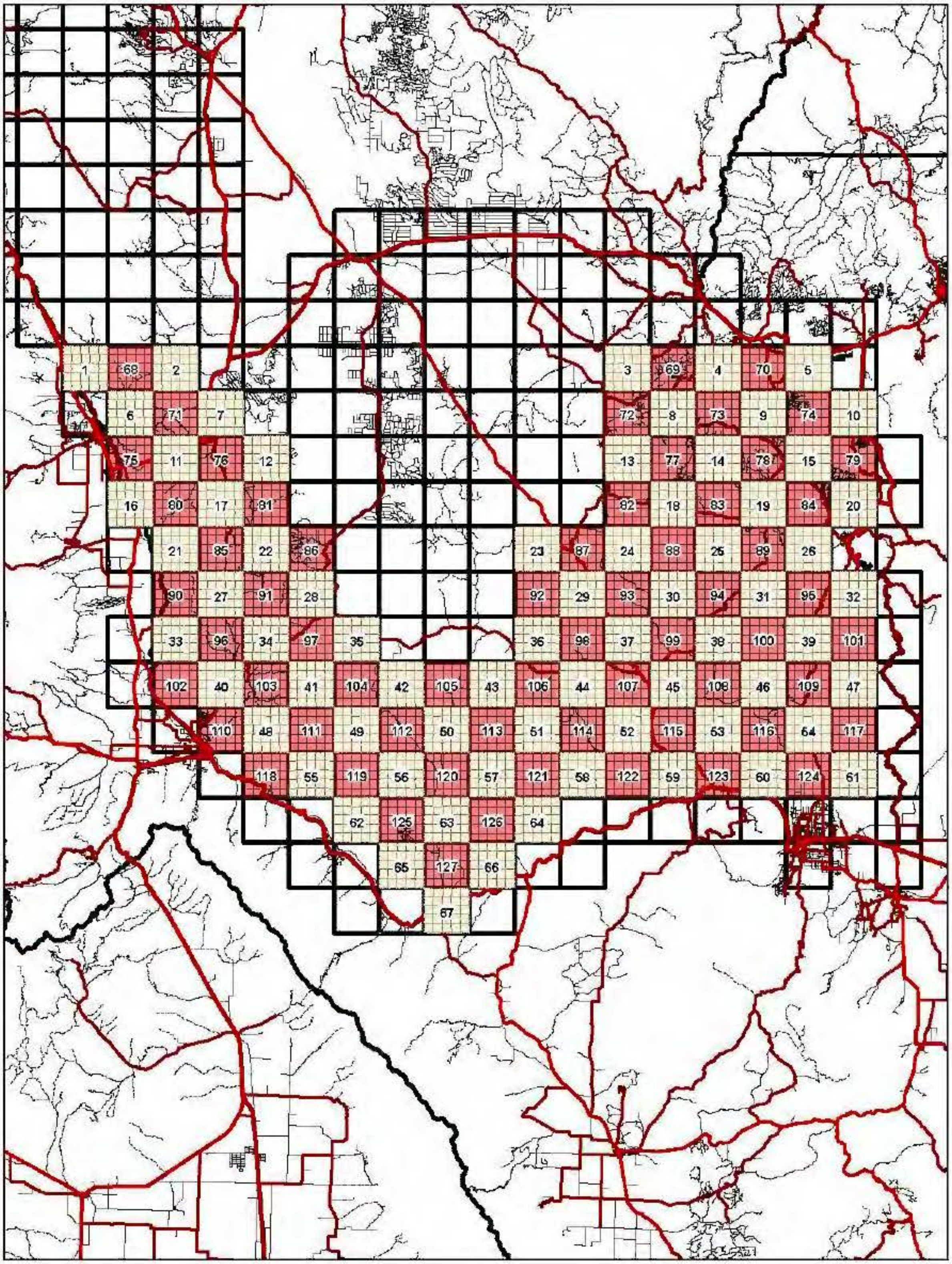

Figure 6: Noninvasive genetic sampling grid overlaid on D-16 study area.

K. Appendix I.

Compliance

Endangered Species Act

The project work in this proposal is non-invasive in nature and does not include any ground disturbing activities. The on-the-ground activity associated with this project will be the capture of cougars using hounds, cage traps, foot hold snares and free-range darting and the capture and radio-collaring of mule deer (Appendix I and II for approved capture and handling guidelines). This project does not involve aquatic work therefore there will be no effect to aquatic species.

Capture of deer and cougars may result in minor disturbance to some threatened species, Gunnison prairie dog, Boreal toad, Mexican spotted owl, and Canada lynx. Because all these species and/or their habitat are conspicuous and easily recognized, if any of these species are encountered, researchers will avoid capture activities in the area near these animals to limit disturbance. Deer and cougar capture has routinely been conducted throughout Colorado, across the range of all these species, and no negative effects have been documented. Therefore, we have determined this project may affect but is not likely to adversely affect the above listed species.

Animal Welfare Act

Prior to capture, this study will gain capture approval through Colorado Parks and Wildlife's Animal Care and Use Committee. Once gained, project approval numbers will be provided. Capture and Handling guidelines are already approved

NEPA

To comply with the National Environmental Policy Act, an Environmental Assessment is being developed by USDA Wildlife Services which will include all above mentioned project activities and their potential impacts.

Other Landscape-Oriented Federal Acts

This project will have no negative impact on the landscape, therefore it will not violate provisions of Federal Legislation governing floodplains, wetlands, historical sites, and prime and unique farmlands.

Americans With Disabilities Act

When hiring personnel as part of this project, qualified individuals will not be discriminated against based on disability. No structures or access points will be constructed as part of this research, and thus accessibility is not applicable.

Federally listed, proposed and candidate species considered for: Teller, Park, Freemont, Chaffee, Custer, Pueblo and Huerfano counties.

Canada Lynx
Wolverine
Preble's Jumping Mouse and critical habitat
Mexican Spotted Owl and critical habitat
Least Tern
Gunnison Sage Grouse
Whooping Crane
Arkansas Darter
Bony Tail Chub
Pike Minnow
Green Back Cutthroat Troat

Hump Back Chub
Pallid Sturgeon
Razor Back Sucker
Penland Alpine Fen Mustard
Western Prairie Fringed Orchid
Pawnee Montane Skipper
Uncompaghre Fritillary Butterfly