FINAL ENVIRONMENTAL ASSESSMENT

PREDATOR DAMAGE AND CONFLICT MANAGEMENT IN WYOMING

Prepared by:

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)

ANIMAL AND PLANT HEALTH INSPECTION SERVICE (APHIS)

WILDLIFE SERVICES (WS) - WYOMING

Cooperating Agencies:

United States Forest Service (USFS)

Wyoming Animal Damage Management Board (ADMB)

Wyoming Department of Agriculture (WDA)

Wyoming Office of Stand Lands and Investments

Wyoming Game and Fish Department (WGFD)

Consulting Agencies:

United States Fish & Wildlife Service (USFWS)

Bureau of Land Management (BLM)

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Table of Contents

List of Acronyms Used

ADMB	Wyoming Animal Damage Management Board
APHIS	Animal and Plant Health Inspection Service
BLM	Bureau of Land Management
BMP	Best Management Practices
BMU	Bear Management Unit

BO	Biological Opinion
BOR	Bureau of Reclamation
CEQ	Council on Environmental Quality
CFR	Codes of Federal Regulations
CVM	Contingent Valuation Method
EA	Environmental Assessment
EIS	Environmental Impact Statement
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
GAV	General Aviation
HMU	Herd Management Unit
IUCN	International Union for Conservation of Nature
IPDM	Integrated Pest Damage Management
IWDM	Integrated Wildlife Damage Management
LMU	Mountain Lion Management Unit
LRMP	Land and Resource Management Plan
MIS	Management Information System
MOU	Memorandum of Understanding
MRA	Minimum Requirements Analysis
NASS	National Agriculture Statistics Service
NED	National Economic Development
NEPA	National Environmental Policy Act
NF	National Forest
NG	National Grassland
NHPA	National Historical Preservation Act
NRCS	Natural Resource Conservation Service
OMB	Office of Management and Budget
PDM	Predator Damage Management
PMB	County Predator Management Boards

PMD	Predator Management District
RMA	Recreation Management Area
RMP	Resource Management Plan
SMA	Special Management Area
SOP	Standard Operating Procedure
TCM	Travel-Cost-Method
T&E	Threatened and Endangered
USACE	US Army Corps of Engineers
USC	United States Codes
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WA	Wilderness Area
WDA	Wyoming Department of Agriculture
WDM	Wildlife Damage Management
WGFC	Wyoming Game and Fish Commission
WGFD	Wyoming Game and Fish Department
WTP	Willingness-to-Pay
WP	Work Plan
WS	Wildlife Services
WSA	Wilderness Study Area

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

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 Wyoming;
- the reasons why private and commercial entities, tribes, and federal, state, and local government agencies request assistance from Wildlife Services (WS)-Wyoming;
- how WS-Wyoming 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-Wyoming; and
- the public involvement and notification processes used by WS-Wyoming 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. For this EA, WS will proceed under the 1978 NEPA regulations and existing APHIS procedures since this EA was initiated prior to the September 14, 2020 NEPA revisions.

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 (USDA)(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-Wyoming 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 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 Wyoming, including the continuation of the current program. The purpose of the EA is to assist WS-Wyoming in understanding the environmental impacts of these alternatives, in order to make an informed decision regarding responses to future requests for PDM assistance in Wyoming, 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-Wyoming 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-Wyoming. This EA includes an analysis of potential impacts on all land classes, including federal, tribal, state, county, municipal, and private properties in rural, urban and suburban areas.

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

Common Name	**Scientific Name**	**Management Authority**	**Wyoming Statutory Classification**
Coyote	*Canis latrans*	WDA[1]	Predatory Animal
Raccoon	*Procyon lotor*	WDA	Predatory Animal
Striped Skunk	*Mephitis*	WDA	Predatory Animal
Red Fox	*Vulpes vulpes*	WDA	Predatory Animal
Badger	*Taxidea taxus*	WGFD[2]	Furbearing Animal
Feral Cat	*Felis domesticus*	WDA	Predatory Animal
White-tailed Jackrabbit	*Lepus townsendii*	WDA	Predatory Animal
Black-tailed Jackrabbit	*Lepus californicus*	WDA	Predatory Animal
Porcupine	*Erethizon dorsatum*	WDA	Predatory Animal
Bobcat	*Lynx rufus*	WGFD	Furbearing Animal
Virginia Opossum	*Didelphis virginiana*	WGFD/WDA	Nongame Animal/Pest
Black Bear	*Ursus americanus*	WGFD	Trophy Game Animal
Mountain Lion	*Puma concolor*	WGFD	Trophy Game Animal
Feral Dog	*Canis domesticus*	Local Government	N/A
Mink	*Neovison vison*	WGFD	Furbearing Animal
Grizzly Bear	*Ursus arctos*	USFWS[3]	Trophy Game Animal
W. Spotted Skunk	*Spilogale gracilis*	WDA	Predatory Animal
E. Spotted Skunk	*Spilogale putorius*	WDA	Predatory Animal
Long-tailed Weasel	*Mustela frenata*	WGFD	Furbearing Animal
Short-tailed Weasel	*Mustela erminea*	WGFD	Furbearing Animal

[1]WDA, Wyoming Department of Agriculture
[2]WGFD, Wyoming Game and Fish Department
[3]USFWS, United States Fish and Wildlife Service

The proposed action (Alternative 1; Section 2.6 and Appendix A), involves WS-Wyoming continuing the 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-Wyoming 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-Wyoming 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 species and species classified as predatory animals under Wyoming statutes: coyote, raccoon, striped skunk, red fox, badger, feral cat, white-tailed jackrabbit, black-tailed jackrabbit, porcupine, bobcat, Virginia opossum, black bear, mountain lion, feral dog, mink, grizzly bear, western spotted skunk, eastern spotted skunk, long-tailed weasel, short-tailed weasel (in order of amount of take by WS-Wyoming; Table 1-1). Most species are managed under state law as predatory animals by the Wyoming Department of Agriculture (WDA). Exceptions include badgers, bobcats, black bears, mountain lions, mink, long-tailed and short-tailed weasels, which are managed by the Wyoming Game and Fish Department (WGFD) as trophy game or furbearers; Virginia opossums, which are managed by the WGFD as nongame wildlife, but are allowed to be taken in accordance with the provisions of W.S. § 11-5-101 through W.S. § 11-5-119 (Weed and Pest Control Act of 1973) under the authority of the WDA; grizzly bears, which are managed by the United States Fish and Wildlife Service (USFWS); and feral dogs, which are managed by local jurisdictions. Gray wolves, while biologically classified as predators, are not covered by this EA. A FONSI was signed on May 10, 2019 for the EA *Gray Wolf Damage and Conflict Management in Wyoming.*

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 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. Millions of Americans also participate in the hunting of wildlife, which also brings considerable income to local economies. Many others find emotional and psychological solace just knowing that wildlife exists in nature. Benefits also accrue to people through these species' roles in sustaining ecosystem function and biodiversity. 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 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?

Summarize how human attitudes towards large carnivores have 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." Similarly, there are also passive use values associated with preserving wildlife for the enjoyment of future generations (i.e. bequest values). 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 many 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, 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. The willingness of individuals to coexist with carnivores can be influenced by self-perceived knowledge about carnivores, the ability for an individual to have vocal input in management decisions, economic concerns, safety concerns, ecological factors, and spiritual or moral beliefs (Young et al. 2015). 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 Undated):

“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 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. 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 Undated).

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-Wyoming, this distinction is purely academic, because the only predator damage management practiced by WS-Wyoming 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. NWRC 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 Act of 1931. 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-Wyoming?

APHIS-WS' mission is to provide federal leadership and expertise to resolve wildlife conflicts to allow people and wildlife to coexist (USDA Wildlife Services 2019j). 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 Wyoming, IWDM activities are funded by Congressional appropriations (about 35%); federal interagency agreements (<1%); and state and local government, and private, commercial, or other cooperators (about 65%). Cooperators are always responsible for contributing a proportion of the costs of operational management, including WS-Wyoming administrative overhead. To facilitate long-term strategic planning, APHIS-WS identified a list of strategic goals in the APHIS-WS 2020-2024 Strategic Plan (U.S. Department of Agriculture 2019), including these functions relevant to WS-Wyoming:

- Developing methods
- Providing wildlife services
- Valuing and investing in people
- Enhancing information and communication

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-Wyoming** 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-Wyoming objectives** are to:

- Professionally and proficiently respond to all reported and verified losses or threats due to predators using the integrated PDM approach and 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, Memorandums of Understanding (MOU), 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 (https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_WS_Program_Directives). 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-Wyoming and the land owner or manager, or, for work on federal lands, a Work Plan (WP) is drafted by WS-Wyoming and then reviewed by the land management administrator or agency representative to ensure it complies with LRMPs/RMPs for USFS lands or BLM lands respectively.

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 WGFD or USFWS, a specific strategy may be requested. WGFD 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 WGFD or USFWS request PDM assistance for protection or management of species under their jurisdiction, especially if the request involves localized population reduction, WS-Wyoming evaluates the potential effectiveness and appropriateness of their involvement before making the decision to assist. For example, WS-Wyoming 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-Wyoming 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 Bureau of Land Management (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-Wyoming 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 Wyoming. WS-Wyoming must ensure that all storage, use, and disposal by WS-Wyoming 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 Wyoming, most native mammalian wildlife species are managed by WGFD. 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 Wyoming Department of Agriculture has management authority of species classified as predatory animals (Wyoming Statute 11-6-302(a)(ix)(A)).

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-Wyoming Work with WGFD, WDA, and Counties

WS-Wyoming, Wyoming Animal Damage Management Board (ADMB), Wyoming Game and Fish Commission (WGFC), and WDA have an MOU which lists responsibilities and authorities as they relate to PDM. Under the MOU, WS-Wyoming has the authority to respond to all conflicts related to predatory animals and is provided guidelines by which WS-Wyoming is authorized to respond to conflicts involving trophy game animals and furbearers. WDA is a primary cooperator with WS-Wyoming for predators because they have the authority to establish cooperative agreements with WS and counties in Wyoming (Wyoming Statute 11-6-108). The ADMB is a primary cooperator with WS-Wyoming. The ADMB is responsible for the formulation of the damage mitigation policy of the state and may adopt rules and regulations necessary for carrying out its duties in accordance with Wyoming Statute 11-6-303. The ADMB is authorized to enter into cooperative agreements with WS-Wyoming (Wyoming Statute 11-6-304). The WGFD is a primary cooperator with WS-Wyoming and utilizes personnel from WS-Wyoming to assist in PDM concerning species that are classified as trophy game animals including black bears (Wyoming Game and Fish Department 2007) and mountain lions (Wyoming Game and Fish Department 2006).

Beside the state agencies, WS-Wyoming also cooperates with many County Predator Management Boards (PMBs). These boards are authorized to exercise general supervision over PDM within their respective Predator Management District (PMD) and administer funds received from predator management fees to carry out their predator management program (Wyoming Statute 11-6-205). Sweetwater, Teton and Platte Counties have chosen not to establish Cooperative Agreements with WS-Wyoming and 9 counties (Sheridan, Johnson, Natrona, Campbell, Converse, Niobrara, Uinta, Laramie, and Crook) only have agreements for limited services at this time (e.g. aerial operations; Figure 1-1.).

These state and county agencies enter into Cooperative Service Agreements with WS-Wyoming. These documents establish the cooperative relationships between WS-Wyoming and the state and county entities, 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 Service 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-Wyoming has authority under the Act of 1931 and subsequent amendments allowing for WS-Wyoming to enter into agreements with public and private entities.

WS-Wyoming policy allows personnel to assist in feral and free-ranging dog control at the request of local authorities in municipal areas, the appropriate landowner on deeded lands, or the designated tribal official on tribal lands, 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 or any County Predator Management Board not currently under a Cooperative Service Agreement with WS-Wyoming 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.

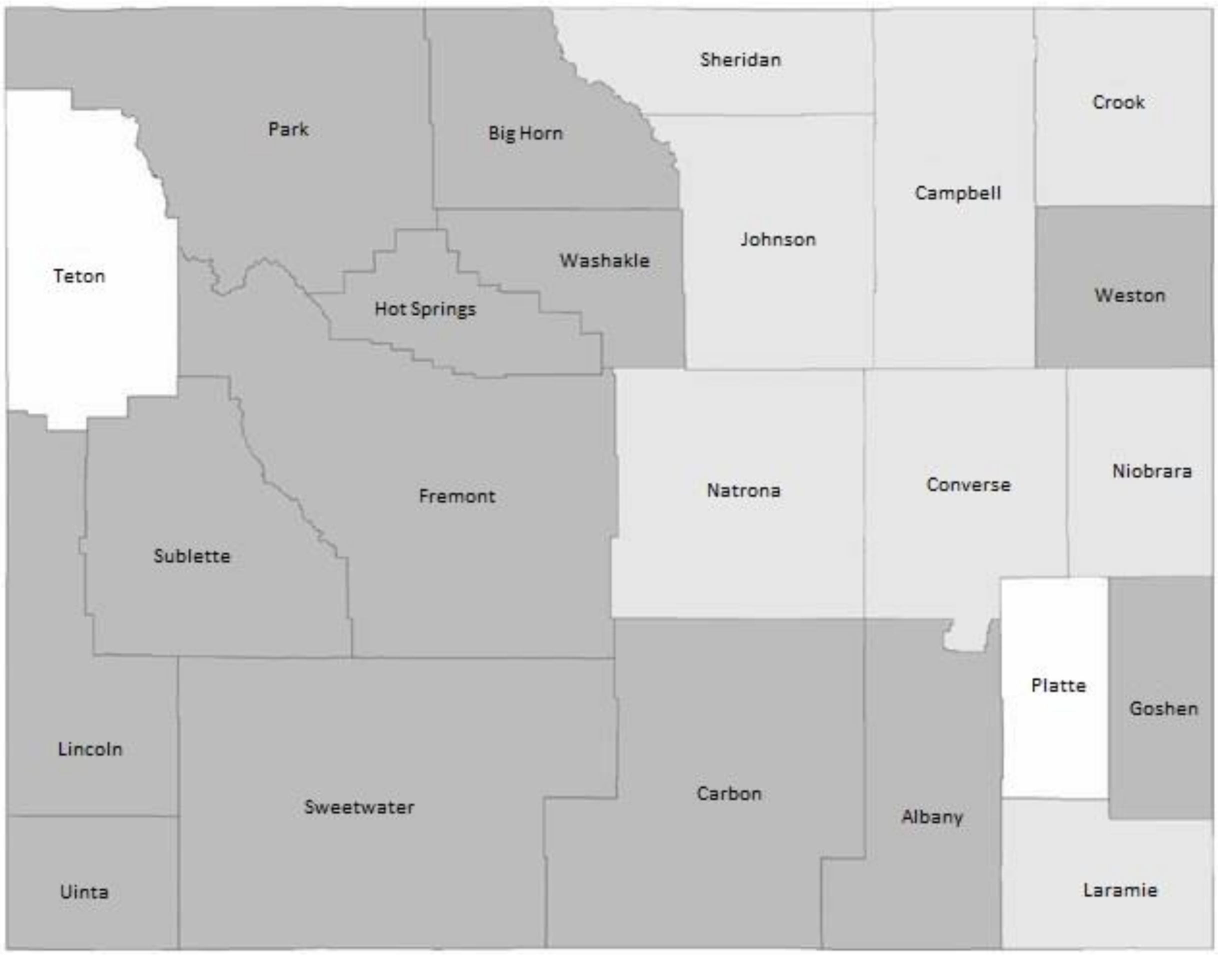

Figure 1-1. Counties shaded dark gray are counties where the Predator Damage Management Boards have entered into Cooperative Service Agreements with WS-Wyoming as of the end of FY 2018. Counties shaded light gray are counties where the Predator Damage Management Boards have entered into Cooperative Service Agreements with WS-Wyoming for limited services (e.g. aerial operations) as of the end of FY 2018. Counties left unshaded (white) are counties that have not entered into any types of agreement with WS-Wyoming.

1.14 How Does WS-Wyoming Work with Federal Agencies?

1.14.1 How Does WS-Wyoming 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 WPs, 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-Wyoming actions under the WPs conform with these land management plans, and with policies specific to each USFS National Forest (NF), USFS National Grassland (NG), or BLM State, District, or Field Office. WS-Wyoming has been requested to operate on most NFs and all BLM Districts within Wyoming. Current WPs involve six NFs, one NGs, and all three BLM Districts for the protection of livestock and/or human safety. All NFs, NGs, and BLM Districts may request WS-Wyoming assistance with emergency work at any time.

All PDM which might be conducted under these WPs is included and analyzed in this EA. The purpose of these WPs is to coordinate with these land management agencies regarding the implementation of the actions analyzed in this EA. WPs might include limitations to the PDM analyzed in this EA. For example, a WP 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 WPs are generally conducted annually. WPs from prior years may be adopted without a work-planning meeting when the agencies determine that no change to the existing WP is warranted, or when no work is expected to be conducted on those lands. WPs might include maps of USFS or BLM lands depicting the locations where limitations on WDM are to be incorporated, or where PDM is expected to occur. Neither the WPs nor the maps associated with them include any PDM method, species, or action outside of the analysis in this EA. WS-Wyoming will conduct PDM in Wilderness Areas (WAs) only when and where specifically authorized by the land management entity on a case by case basis. PDM activities conducted in all other SMAs including Wilderness Study Areas (WSAs) and Recreation Management Areas (RMAs) would be in accordance with the MOUs and WPs between WS-Wyoming and the land management agencies, and all enacted rules and regulations that are applicable to WS-Wyoming. Any National Forest not currently under a WP with WS-Wyoming may enter into one consistent with the analyses and impacts in this EA, APHIS-WS and USFS policies and directives, and thereby the activities would be covered by this EA.

For this EA, the USFS is a cooperating agency and the BLM is a consulting agency. Each agency has been involved with this EA to ensure consistency with their land management plans. In Wyoming, National Forests (NFs) and National Grasslands (NGs) include:

- Ashley NF
- Bighorn NF
- Black Hills NF
- Bridger-Teton NF
- Caribou-Targhee NF
- Medicine Bow NF
- Shoshone NF
- Wasatch-Cache NF
- Thunder Basin NG

BLM has three districts in Wyoming, encompassing ten Field Offices. Most of these have their own Resource Management Plans (RMPs):

High Desert District	**High Plains District**	**Wind River/Bighorn Basin (Northwest) District**
Kemmerer Field Office	Casper Field Office	Cody Field Office
Pinedale Field Office	Buffalo Field Office	Lander Field Office
Rawlins Field Office	Newcastle Field Office	Worland Field Office
Rock Springs Field Office		

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 WPs 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 WPs 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 WAs and WSAs.

1.14.2.2 2012 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.
- WS and BLM will follow stipulations in any subsequent versions of the WS-BLM MOU.

1.14.3 How does WS-Wyoming Work with Federal Agencies to Review Proposed Work in Wilderness Areas and Wilderness Study Areas?

For non-emergency WS-Wyoming activities proposed in WAs and WSAs, WS-Wyoming would present the proposed activities for the year to the BLM and USFS during their respective annual work plan meetings. For PDM activities proposed in designated USFS-managed wilderness, approval by the Regional Forester is required on a case-by-case basis. A minimum requirements analysis (MRA) would be necessary, using the Minimum Requirements Decision Guide. Work proposed in wilderness study areas managed by either agency would be included in the annual work plan process. The agencies will determine if the proposed activities have adequate NEPA coverage prior to approving those projects in wilderness study areas.

While there are currently no designated WAs under BLM management in Wyoming, Congress could designate lands that are currently designated as WSAs under BLM management as WAs in the future. If this happened, for activities proposed for the year in designated BLM-managed wilderness, WS-Wyoming and the BLM would use the Minimum Requirements Decision Guide to conduct a minimum requirements analysis on the year's proposed activities. If the Minimum Requirements Decision Guide is approved, the BLM may conduct a site-specific, standalone NEPA analysis and make a decision to approve or deny the annual proposed activities of WS-Wyoming. If additional NEPA is deemed necessary, the analysis provided in this EA may be used to inform that decision-making process. The BLM may adopt the WS-Wyoming analysis conducted through this NEPA process programmatically and/or through a site specific annual NEPA decision to approve or deny the annual proposed activities of WS-Wyoming. If there is sufficient NEPA coverage in place that adequately analyzed the work proposed in the annual work plan and Minimum Requirements Decision Guide, BLM may issue a Determination of NEPA Adequacy for the year's plans.

1.14.4 How Does WS-Wyoming Work with the US Fish and Wildlife Service?

When WDM activities may affect federally listed threatened or endangered species, WS-Wyoming 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-Wyoming activities on federally listed species in Wyoming have been evaluated by WS-Wyoming in Biological Assessments (dated April 4, 2007, November 21, 2014 & January 15, 2015)(USDA Wildlife Services 2007;2014a;2015b). Mitigation measures to decrease the likelihood of impacts were included in these assessments. The USFWS responded with Biological Opinions (dated September 28, 2007, March 10, 2015)(U.S. Fish and Wildlife Service 2007b;2015b) and concurrence letters (dated February 6, 2015 and May 28, 2019)(U.S. Fish and Wildlife Service 2015a;2019), which concurred with WS-Wyoming's assessments, and mitigation measures. WS-Wyoming closely follows these mitigation measures outlined in its ESA consultation documents in order to minimize the risk of take of listed species. WS-Wyoming may also assist the USFWS in protecting ESA-listed species, when requested.

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

APHIS-WS has a national MOU 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.

1.14.5 How Does WS-Wyoming Work with the FAA and NASAO?

WS-Wyoming 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.

1.14.5.1 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-Wyoming Comply with NEPA?

1.15.1 How Does NEPA Apply to WS-Wyoming'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-Wyoming WDM activities, including PDM, are federal actions, and are thus subject to NEPA. WS-Wyoming 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 WDA and WGFD 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 Wyoming and to ensure that the analysis is complete for informed decision-making, WS-Wyoming 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_assess-ments) 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 Wyoming Tribune Eagle*. 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-Wyoming is coordinating the preparation of this EA with cooperating partner agencies, including WGFD, WDA, Wyoming State Land Board, and USFS. Additionally, BLM and USFWS served as consulting agencies in this process. WS-Wyoming also recognizes the sovereign rights of Native American tribes to manage wildlife on tribal properties, and has invited the Eastern Shoshone and Northern Arapaho tribes to cooperate or participate in the development of this EA. The WS-Wyoming 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-Wyoming's Decisions?

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

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

- 1998 EA and Decision/FONSI for Predator Damage Management in Eastern Wyoming (USDA Wildlife Services 1998)
- 1997 EA and Decision/FONSI for Predator Damage Management in Western Wyoming (USDA Wildlife Services 1997a)

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. WS-Wyoming must be ready to provide assistance on short notice anywhere in Wyoming 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 Wyoming for which WS-Wyoming 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-Wyoming 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 (Slate et al. 1992, USDA Wildlife Services 2014b) 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-Wyoming's objectives. These site- specific actions are included in the analyses in Chapter 3.

Site-specific limitations are sometimes outlined in WPs. All PDM which might be conducted under these WPs is included and analyzed in this EA, as discussed in Section 1.14.1. For example, a WP 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 Wyoming. Areas in which WS-Wyoming 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. Wyoming is comprised of about 44% private lands, 29% BLM lands, 14% USFS lands, 5% state lands, 4% NPS lands, 3% tribal lands, and less than 1% local government and other federal agency lands.

1.15.4.1 Private Lands

Private and commercial property owners and/or managers of private property request WS-Wyoming 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 Federally Managed Public Lands

Per the MOUs with the USFS and BLM, WS-Wyoming responds to permittee and agency requests for PDM to protect livestock on federal grazing allotments, and for the protection of human safety. WS-Wyoming coordinates with the agencies prior to the grazing/recreation seasons to identify needs, types of operations, and restrictions (documented in a WP), and reports annually to the agencies on WS-Wyoming activities. WS-Wyoming 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 Wyoming 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-Wyoming for PDM on lands under their authority and/or ownership. WS-Wyoming has an MOU with the Eastern Shoshone and Northern Arapaho Tribes to conduct conflict management activities. Predators have an important role in tribal culture and religious beliefs. WS-Wyoming 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-Wyoming, 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-Wyoming respects the rights of sovereign tribal governments, provides early opportunities for all federally-recognized tribes in Wyoming 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?

If WS-Wyoming determines that the analyses in this EA indicate that an EIS is not warranted (impacts are not significant per 40 CFR §1508.27; Section 1.10), this EA remains valid until WS-Wyoming determines that new or additional needs for action, changes in the human environment, new issues, and/or new alternatives having different environmental impacts need to be analyzed to keep the information and analyses current. At that time, this analysis and document would be reviewed and, if appropriate, supplemented if the changes would have “environmental relevance” (40 CFR 1502.9(c)), or a new EA prepared pursuant to the NEPA.

WS-Wyoming monitors PDM activities conducted by its personnel and ensures that those activities and their impacts remain consistent with the activities and impacts analyzed in the 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 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-Wyoming Preparing and 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-Wyoming can make an informed decision on whether or not an EIS is warranted for the WS-Wyoming PDM program, and whether an alternative to the proposed action would be more appropriate.

WS-Wyoming 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-Wyoming PDM activities. WS-Wyoming 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 Wyoming, including no WS-Wyoming 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-Wyoming activities and alternatives in detail, and provides rationale for not considering other alternatives and issues in detail.

WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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 Wyoming?

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-Wyoming 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 Wyoming.

1.16.3 How will WS-Wyoming 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-Wyoming 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-Wyoming 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 (WGFD, WDA, 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-Wyoming 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 2014 through 2018 (FY14-18) as the internal analysis period for this EA; data from the WS MIS pertaining to WS-Wyoming 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 WGFD at more local levels, referred to as Herd Management Units (HMUs), Bear Management Units (BMUs) and Mountain Lion Management Units (LMUs). These species include deer, elk, pronghorn, black bears, mountain lions, and others. In addition, the need for PDM is often unpredictable, so WS-Wyoming 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-Wyoming collaborates with WGFD to monitor the potential for impacts on wildlife populations in Wyoming.

WGFD has management authority over the management of most wildlife species in Wyoming, and the decision of WGFD 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.

1.16.4 What is the Environmental Baseline Used by WS-Wyoming 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-Wyoming PDM which have been conducted in Wyoming 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-Wyoming Program?

Numerous federal statutes and executive orders apply to the WS-Wyoming program, including PDM conducted by WS-Wyoming. Some of the key documents are described below; see Appendix C 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 WDA. WS-Wyoming uses or recommends for use all chemicals according to label requirements as regulated by EPA and WDA.

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-Wyoming has consulted with the USFWS regarding its current program. See Section 3.6 for details on consultations and results.

1.16.5.3 National Historic Preservation Act

In 2015 WS-Wyoming contacted the Wyoming State Historic Preservation Office requesting written concurrence that WS-Wyoming's integrated wildlife damage management program is not likely to adversely affect historic properties or archeological sites. WS-Wyoming subsequently received a concurrence letter (Letter dated 10/30/2015 from R. Currit to M. Pipas) stating the majority of actions described did not have the potential to cause effects to historic properties. For those activities, no further consideration of Section 106 is needed. The letter also stated any projects involving ground disturbance, would require further evaluation. None of the methods described in the EA for potential operational local use by WS-Wyoming causes: major ground disturbances; physical destruction, damage or alterations to property, or to wildlife habitats 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. WS-Wyoming works closely with the USFS and BLM on public lands to ensure there are no conflicts with cultural resources. WS-Wyoming has also reached out to tribes as discussed under "Consultation and Coordination with Indian Tribal Governments" in this section. Therefore, the methods that would be used by WS-Wyoming under the proposed action are not generally the types of activities that would have the potential to affect historic properties.

WS-Wyoming recently contacted the Wyoming State Historic Preservation Office for guidance on the necessity of an updated or more recently dated concurrence letter. The provided guidance indicated that given WS-Wyoming's operational methods and resulting effects have not changed since the issuance of the letter, it is not necessary for WS-Wyoming to obtain another concurrence letter as the previously issued concurrence letter remains valid (Pers. Comm. R. Currit, December 3, 2019, phone call)

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-Wyoming 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-Wyoming 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-Wyoming has offered early opportunities for formal government-to-government consultation on its proposed program to all Tribes in Wyoming 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 Wyoming to the State of Wyoming, specifically WDA. WS-Wyoming as a federal agency is exempted from the provisions of the Act and therefore not required to obtain a permit from WDA. Other commercial or private entities must obtain a permit from WDA (to fly any land) and obtain permission from the BLM and/or FS (when flying federal land) in order to meet the provisions of the Act and use aerial operations for PDM.

1.16.5.6 Compliance with Executive Order 12898 "Environmental Justice

WS-Wyoming 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, WDA, by MOUs with Federal land management agencies, and by APHIS-WS Directives. In Chapter 3 of this EA, WS-Wyoming provides a risk assessment of chemicals used during PDM.

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 Wyoming have historic grazing allotments and WS-Wyoming may conduct limited PDM in them in compliance with federal and Wyoming laws. See Section 3.5 for an analysis of impacts on federal lands, including wilderness areas. WS-Wyoming 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-Wyoming 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. USFWS 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-Wyoming would use those immobilizing and euthanasia drugs.

1.17 What is the Need for the WS-Wyoming Program?

1.17.1 What is the Need for WS-Wyoming 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-Wyoming 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-Wyoming personnel recommend that cooperators take non-lethal action in lieu of or in addition to direct and sometimes lethal actions taken by WS-Wyoming 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 an integrated approach to PDM.

A variety of species are responsible for the depredation of a wide variety of livestock, other agricultural resources, property and natural resources in Wyoming (Table 1-3). In addition, predators can be a threat to human health and safety (*e.g.*, in 2018 a 37-year-old male was killed by a grizzly bear while guiding a hunter in Teton County, Wyoming). Figures 1-2 and 1-3 show the amount of damage from select predators recorded by WS-Wyoming from FY14 through FY18 by numbers of livestock reported as a loss (Figure 1-2) and by the value of the reported losses (Figure 1-3). 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. He also determined that, based on scientific studies and livestock loss surveys generated by the National Agriculture Statistics Service (NASS), WS 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-Wyoming, and WS-Wyoming Specialists do not attempt to locate every livestock kill reported by ranchers. The goal of WS-Wyoming Specialists is to verify sufficient losses to determine if a predator problem exists which requires PDM actions. Therefore, WS' 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-Wyoming were $936,466 during FY14-18. Most of these losses were to livestock, with losses of 6,325 head of livestock valued at $852,704. These values represent only a fraction of the total losses, because not all losses are reported to WS-Wyoming. In general, the only losses reported to WS-Wyoming are those for which a cooperator hopes to limit future losses by working with WS-Wyoming 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-Wyoming. During FY14-18, coyotes caused the most damage: $132,292 per year, which is 71% of the total damage. Almost all damage from coyotes was inflicted on livestock, with some damage occurring to natural resources. Coyotes also caused sporadic losses to property and pets.

Based on the losses reported to WS-Wyoming, mountain lions caused the 2nd most damage, valued at $13,174 per year, which is 7% of the total damage. This was predominately due to livestock losses. Mountain lions also caused damage to pets on an annual basis and sporadically damaged property and natural resources. As noted, these data do not likely include all losses suffered in Wyoming, especially for pets, because pet owners are not likely to contact WS-Wyoming regarding such losses.

Grizzly bears caused the 3rd most damage, valued at $12,366 per year, which is 7% of the total damage. All of this was from livestock losses with the exception of one threat to human health & safety that was also recorded. These three predators combined were responsible for 84% of the damage recorded by WS-Wyoming.

It is important to note these loss numbers represent what is reported to WS-Wyoming by cooperators and represents only a portion of damage that is occurring within Wyoming. Wyoming Statute 23-1-901 establishes the WGFD as the primary authority within Wyoming for investigating and paying compensation for damages incurred from big or trophy game or game birds in the state. Any assistance provided by WS-Wyoming in response to these species is at the request and under the direction of WGFD.

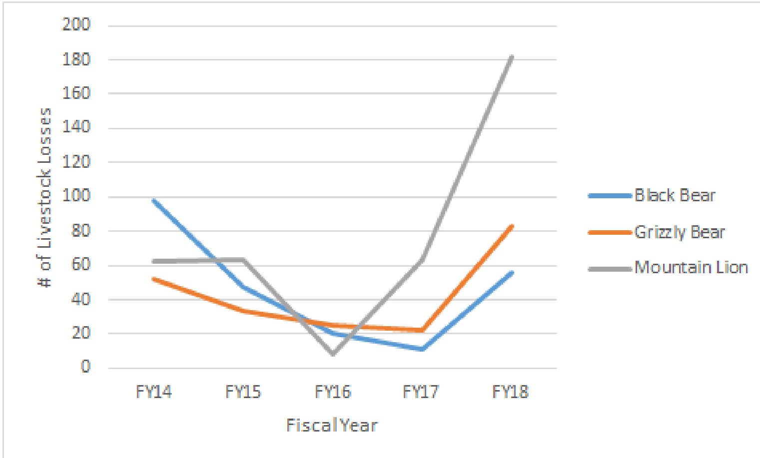

Figure 1-2. Number of livestock losses for select species reported to WS-Wyoming from FY14 through FY18.

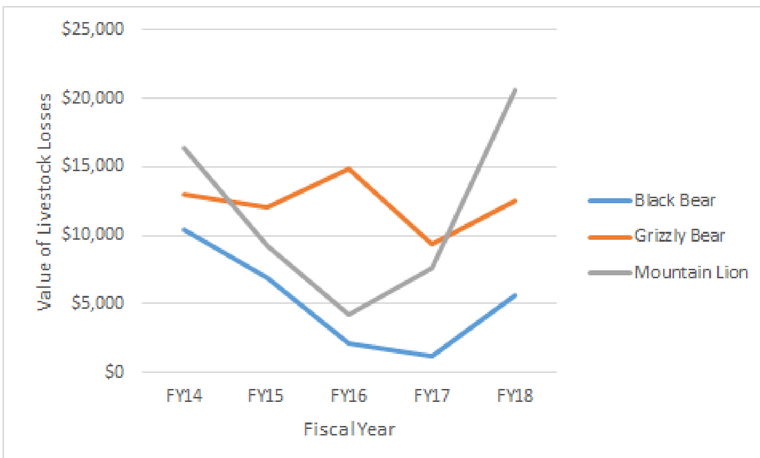

Figure 1-3. Value of livestock losses reported to WS-Wyoming from FY14 through FY18.

Table 1-3. Average annual losses due to predators in Wyoming recorded by WS Specialists from FY14 through FY18. 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.

Species	Livestock		Crops[a]	Other Agri[a]	Pets		Property[a]		Human Health and Safety	Natural Resources		Total
	#[b]	Value	Value	Value	#[b]	Value	#[b]	Value	#[b]	#[b]	Value	Value
Badger	7	$7,230	-	-	-	-	1	$99	-	3	<$1	**$7,329**
Black Bear	46	$5,271	-	-	-	-	-	-	<1	-	-	**$5,271**
Grizzly Bear	43	$12,366	-	-	-	-	-	-	<1	-	-	**$12,366**
Bobcat	27	$950	-	-	-	-	-	-	-	-	-	**$950**
Feral Cat	-	-	-	-	-	-	4	$40	<1	-	-	**$40**
Coyote	933	$124,499	-	-	<1	$42	<1	$60	-	8	$7,692	**$132,292**
Feral Dog	26	$2,960	-	-	-	-	-	-	-	-	-	**$2,960**
Red Fox	92	$4,475	-	-	<1	$6	4	$400	-	-	-	**$4,881**
White-tailed Jackrabbit	-	-	-	$60	-	-	<1	$60	-	-	-	**$120**
Mountain Lion	75	$11,600	-	-	1	$80	<1	$60	-	<1	$1,434	**$13,174**
Mink	5	$96	-	-	-	-	-	-	-	-	-	**$96**
Porcupine	1	$963	-	$210	-	-	-	-	-	<1	$140	**$1,313**
Raccoon	10	$128	$6,198	$58	-	-	2	$60	2	-	-	**$6,445**
Striped Skunk	-	-	-	-	<1	$12	3	$41	1	-	-	**$53**
Weasel	<1	$1	-	-	-	-	-	-	-	-	-	**$1**
Total	**1265**	**$170,541**	**$6,198**	**$328**	**3**	**$140**	**16**	**$820**	**5**	**11**	**$9,266**	**$186,473**

[a]"Other Agri." Is other agriculture, including livestock feed, hay bales, and commercial timber; "Property" includes buildings, equipment, guard animals, landfills, recreational areas, turf and/or flowers, and vehicles.

[b]Numbers of animals includes animals killed or injured; number of items includes items damaged or destroyed.

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

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

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 sheep and lamb losses (Table 1-4) and cattle and calf losses (Table 1-5) reported to WS-Wyoming Specialists. These losses are only those reported to WS-Wyoming during FY14-18.

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 and Grant 2010). In Wyoming, 17.9-28.3% of sheep producers and 4.2% of cattle producers reported losses due to predators during 2014 and 2015, respectively (USDA Veterinary Services 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 Jr. 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 in 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 Jr. and Shaw 1978, Nass 1980, O'Gara et al. 1983, Bodenchuk et al. 2002).

Table 1-4. Annual sheep and lamb losses due to predators in Wyoming recorded by WS Specialists from FY14 through FY18. Data include only those losses reported by cooperators or verified by WS Specialists and recorded in MIS.

Species	FY 2014		FY 2015		FY 2016		FY 2017		FY 2018		Average	
	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value
Badger	-	-	-	-	2	$238	1	$106	-	-	**<1**	**$69**
Black Bear	101	$10,450	47	$6,972	20	$2,118	11	$1,171	56	$5,645	**47**	**$5,271**
Grizzly Bear	45	$3,767	23	$2,859	-	-	-	-	73	$7,538	**28**	**$2,833**
Bobcat	2	$167	-	$0	1	$119	-	-	-	-	**<1**	**$57**
Coyote	1131	$125,090	588	$78,723	696	$79,985	744	$79,296	1208	$130,552	**873**	**$98,729**
Feral Dog	9	$1,082	12	$1,239	16	$1,642	76	$8,099	11	$1,034	**25**	**$2,619**
Red Fox	40	$3,349	18	$2,156	15	$1,787	18	$1,912	61	$6,443	**30**	**$3,129**
Mountain Lion	54	$5,005	60	$8,892	7	$769	60	$6,377	172	$17,695	**71**	**$7,748**
Total	**1382**	**$148,910**	**748**	**$100,841**	**757**	**$86,658**	**910**	**$96,961**	**1581**	**$168,907**	**1076**	**$120,455**

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

Table 1-5. Annual cattle and calf losses and injuries due to predators in Wyoming recorded by WS Specialists from FY14 through FY18. Data include only those losses reported by cooperators or verified by WS Specialists and recorded in MIS.

Species	FY 2014		FY 2015		FY 2016		FY 2017		FY 2018		Average	
	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value
Badger	-	-	-	-	10	$25,646	8	$10,000	-	-	**4**	**$7,129**
Grizzly Bear	6	$6,915	10	$9,200	25	$14,872	22	$9,405	10	$4,980	**15**	**$9,074**
Coyote	26	$19,049	14	$5,679	59	$26,092	51	$20,502	109	$56,192	**52**	**$25,503**
Feral Dog	-	-	-	-	-	-	3	$1,206	1	$498	**<1**	**$341**
Mountain Lion	5	$3,927	-	-	-	-	3	$1,206	1	$498	**2**	**$1,126**
Porcupine	-	-	-	-	-	-	5	$4,816	-	-	**1**	**$963**
Total	**37**	**$29,891**	**24**	**$14,879**	**94**	**$66,610**	**92**	**$47,135**	**121**	**62168**	**74**	**$44,137**

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

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

In 2017, agriculture generated $1.47 billion in annual sales from agricultural products in Wyoming (National Agricultural Statistics Service 2019) Livestock, poultry, and their products accounted for $1.15 billion (78%) of this and is therefore considered a primary agricultural industry sector in the state. Cattle, sheep, and swine production contributes substantially to local economies. Wyoming livestock inventories in 2017 included 1,308,867 cattle and calves, 367,702 sheep & lambs, 89,780 swine, and 36,961 chickens (National Agricultural Statistics Service 2019) In addition, goats, other poultry, rabbits, and emus are produced in Wyoming, but at lower levels (National Agricultural Statistics Service 2019) Sheep inventories in Wyoming have increased over the last few years from a low of 345,000 in 2015 (National Agricultural Statistics Service 2017).

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).
- 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 Jr. 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?

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 ((USDA Veterinary Services 2015); Table 1-6). Calf losses due to predators represented 11% of total calf losses in 2015 (USDA Veterinary Services 2017). Cattle and calf losses have shown a 20 year trend of increasing predation losses nationally ((USDA Veterinary Services 2017), Figure 1-4). This predation loss accounts for 238,900 calves killed by predators, at a value of $117.3 million in 2016 (USDA Veterinary Services 2017).

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 calves (VS 2017) and lambs (VS 2015).

	% Total Predator Loss		Number of Head	
Predator Species	**Calves**	**Lambs**	**Calves**	**Lambs**
Coyotes	53.1	63.7	126,810	84,534
Dogs	6.6	10.3	15,740	13,701
Cougars/Bobcats	5.7	4.5/2.8	13,580	5,920/3,736
Bears	2.1	3	4,940	4,018
Other[1]	36	15.7	77,819	26,629

[1]Includes calf losses from 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.

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

The percentage of cattle operations which used non-lethal methods increased from 3% in 2000 to 19% in 2015 (USDA Veterinary Services 2017). Cattle operators spent an average of $2,962 per ranch on non-lethal methods in 2015 (USDA Veterinary Services 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%) (USDA Veterinary Services 2017). These surveys did not include information on any lethal management that might have been occurring simultaneously.

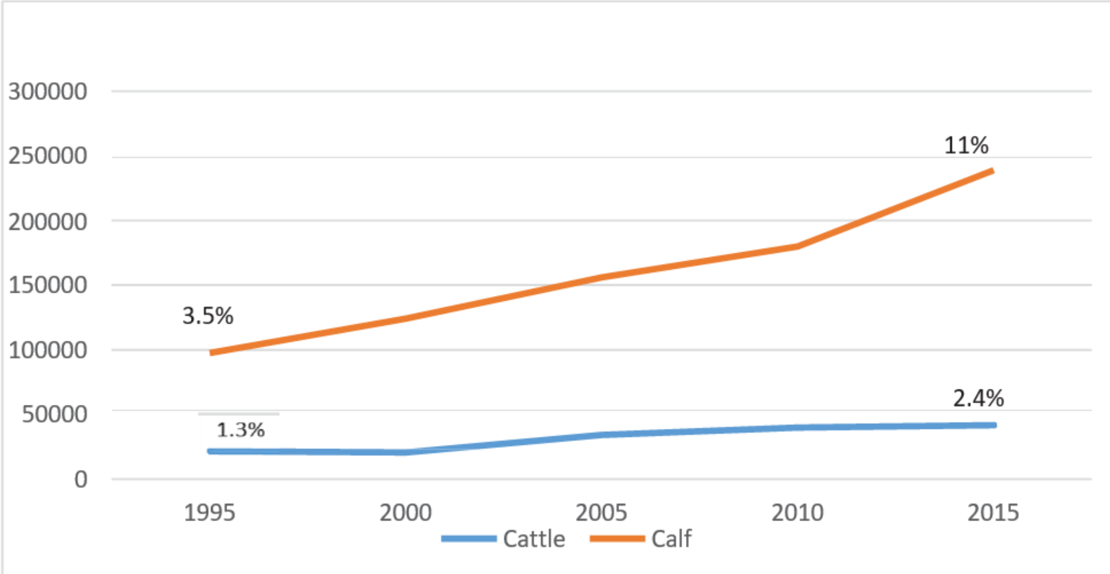

Figure 1-4. Number of and percentage of cattle and calves killed by predators nationally. Data from United States Department of Agriculture-Veterinary Services, 2017.

1.17.2.4 What are Livestock Losses to Predators in Wyoming?

USDA APHIS Veterinary Services conducted a comprehensive national surveys of sheep and lambs lost to predators in 2014 (USDA Veterinary Services 2015).. USDA Veterinary Services (2015) reported that predators (coyotes, black bears, feral dogs, mountain lions, bobcats, wolves, vultures and foxes) killed 1,428 adult sheep valued at $313,900, and 6,662 lambs valued at $799,000 in Wyoming in 2014. The percentage of sheep and lamb operations that reported losses to predators in 2014 in Wyoming was 17.9% for sheep and 28.3% for lamb operations (USDA Veterinary Services 2015). Of the sheep and lambs killed by predators in 2014, coyotes were responsible for about 64%, dogs 26%, mountain lions 4%, Other 3%, foxes 2%, and bobcats <1% (USDA Veterinary Services 2015).

USDA APHIS Veterinary Services also conducted a comprehensive national survey of cattle and calves lost to predators in 2015 (USDA APHIS Veterinary Services 2017). USDA APHIS Veterinary Services (2017) reported that predators (grizzly bears, black bears, bobcats or lynx, coyotes, dogs, foxes, wolves, predatory birds, mountain lions, other predators, and unknown predators) killed 620 adult cattle and 2,780 calves (USDA Veterinary Services 2017). In Wyoming, 4.2% of cattle operations reported losses to predators in 2015 (VS 2017). Of predation losses to adult cattle in Wyoming in 2015,wolves were responsible for 18.4%, grizzly bears 12.9%, coyotes 4.6%, black bears 2.7% and mountain lions 2%, other predators 1.1% and unknown predators 58.3% (USDA Veterinary Services 2017). Of predator losses to calves in 2015, coyotes were responsible for 33.6%, grizzly bears 17%, wolves 16.8%, mountain lions 6.9%, predatory birds 5% black bears 1.2%, dogs 0.6%, foxes 0.1%, other predators 0.1%, and unknown predators 18.7% (USDA Veterinary Services 2017).

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-Wyoming personnel.

1.17.2.5 What are Livestock Producers Doing to Prevent Predation?

USDA Veterinary Services and NASS statewide and national damage surveys reported preventative measures used by producers, including fencing, hazing, guarding, and other methods (National

Agricultural Statistics Service 2011, USDA Veterinary Services 2015). Table 1-7 shows the percentage of producers surveyed that used non-lethal strategies to prevent losses of cattle, calves, (National Agricultural Statistics Service 2011) and sheep (USDA Veterinary Services 2015) from predators in Wyoming. Culling refers to the removal of older and more vulnerable livestock from the inventory.

Table 1-7. Percentage of Wyoming 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, VS 2015).

Non-lethal Method	Resource Protected	
	Cattle and Calves	Sheep and Lambs
Exclusion fencing	23.5%	24.5%
Frequent checks	47%	29.4%
Carcass removal	42.9%	19.9%
Culling	28.3%	34%
Night penning	19.4%	33.9%
Herding	22.7%	13.5%
Fright/harassment tactics	3.5%	7.1%
Guard Animals	19.8%	-
Guard dogs	-	36.1%
Llamas	-	15.6%
Donkeys	-	6.9%
Shed lambing	-	46.6%
Changing bedding	-	12.8%
Altered breeding season	-	5.4%
Other	8.3%	7.6%

WS-Wyoming is typically contacted by landowners who have attempted several non-lethal strategies on their own. After receiving a request for assistance, WS-Wyoming 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-Wyoming 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.

1.17.2.6 What Diseases Do Predators Transmit to Livestock in Wyoming?

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 Wyoming predator populations. However, since these pathogens are known to circulate in predator populations outside of Wyoming, it is possible that some pathogens may be undetected in Wyoming 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 2010, McAllister 2014, Centers for Disease Control and Prevention 2019); and others. WS-Wyoming has not been requested to conduct PDM specifically for livestock disease control, but PDM activities for other reasons can indirectly assist disease control efforts.

1.17.2.7 What is the WS-Wyoming Predator Damage Management program and how does it provide service?

WS-Wyoming responds to wildlife damage complaints from cooperators ranging from private citizens to other agencies. WS-Wyoming recorded damage caused by 15 predator and predatory animal species from FY14 through FY18 (Table 1-3). The biggest portion of the WS-Wyoming program is to resolve conflicts between coyotes and livestock, and this is reflected in the amount of losses that WS-Wyoming recorded.

WS-Wyoming conducts PDM in cooperation with several other agencies in Wyoming. WDA is a primary cooperator with WS-Wyoming for predators because they have the authority to establish cooperative agreements with WS and counties in Wyoming (Wyoming Statute 11-6-108). The ADMB is a primary cooperator with WS-Wyoming. The ADMB is responsible for the formulation of the damage prevention management policy of the state and may adopt rules and regulations necessary for carrying out its duties. The ADMB is also allowed to enter into cooperative agreements with WS-Wyoming (Wyoming Statute 11-6-304). The WGFD is a primary cooperator with WS-Wyoming and utilizes personnel from WS-Wyoming to assist in PDM concerning species that are classified as trophy game animals including black bears (Wyoming Game and Fish Department 2007) and mountain lions (Wyoming Game and Fish Department 2006).

WS-Wyoming, ADMB, WGFC, and WDA have an MOU which lists responsibilities and authorities as they relate to PDM. Under the MOU, WS-Wyoming has the authority to respond to all conflicts related to predatory animals and is provided guidelines by which WS-Wyoming is authorized to respond to conflicts involving trophy game animals and furbearers. WS-Wyoming acts as an agent for entities requesting assistance with agricultural depredations and for private individuals that request assistance in reducing damage to private property.

WS-Wyoming is a cooperatively funded, service-oriented program. Cooperators range from private citizens to other agency personnel. Beside the state agencies, WS-Wyoming also cooperates with many PMBs. These boards are authorized to exercise general supervision over PDM within their respective predator management district and administer funds received from predator management fees to carry out their predator management program (Wyoming Statute 11-6-205). WS-Wyoming focuses most PDM efforts in the areas where funding allows for staffing. Sweetwater, Teton and Platte Counties have chosen not to establish Cooperative Agreements with WS-Wyoming and 9 counties (Sheridan, Johnson, Natrona, Campbell, Converse, Niobrara, Uinta, Laramie, and Crook) only have agreements for limited services at this time (e.g. aerial operations; Figure 1-1**.**). WS-Wyoming generally conducts limited work in non-cooperating counties but may consider more projects as funding becomes available from interested governmental agencies and private individuals.

Wyoming encompasses about 97,411 mi^2 (62,343,040 acres) in 23 Counties (Figure 1-1). The human population has grown from 332,416 in 1970 to 577,737 citizens in 2018 resulting in an approximately 74% growth in the last 48 years (CensusScope 2010, Wyoming Economic Analysis Division 2018). The growth in the human population and many wildlife species has 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 Wyoming is to provide leadership to protect resources from wildlife damage and conflict. The WS-Wyoming program is divided into three geographic Districts: Northwest (northwestern Wyoming), Southwest (Southwestern Wyoming), and Eastern (approximately the eastern third of Wyoming). WS-Wyoming receives requests for PDM throughout Wyoming. 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 1-1; however, assistance may be provided anywhere in Wyoming where a need exists, and funding is available to cover such actions.

1.17.3 What is the Need for PDM in Wyoming for Protecting Agriculture Resources and Property other than Livestock?

Several other agricultural commodities can be damaged by predators such as livestock feed, hay bales, and commercial timber. During FY14-18, most of this type of damage has been sporadic, and most has involved porcupines and raccoons. White-tailed jackrabbits also caused some damage. WS-Wyoming recorded an average of $328 in annual losses to these resources due to predators (Table 1-3). This only includes those losses reported to WS-Wyoming; not all losses are reported to WS-Wyoming. Several other species can be responsible for these types of damage, but such damages were not recorded by WS-Wyoming in FY14-18. 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 Wyoming for Protection of Public Safety, Health, and Pets from Predators?

WS-Wyoming conducts some PDM in Wyoming to reduce human health and safety concerns for the public. All WS-Wyoming PDM for human health and safety concerns involving mountains lions and black bears is conducted at the request and under direction of the WGFD. WS-Wyoming PDM for human health and safety concerns involving grizzly bears is at the request and under the direction of the USFWS and the WGFD. Human health and safety concerns could include: human attacks from mountain lions, black bears, grizzly 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 foxes crossing runways at airports or airbases.

One of the biggest threats to public safety is attacks on people by large predators. 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 1992). No lion-caused fatalities have been documented in Wyoming in FY14-18, but one non-fatal attack has occurred in the past.

Coyotes can also be a threat to human safety, as discussed below. WS-Wyoming could assist residents, especially in urban or suburban areas concerned about coyote attacks on their pets. Predator attacks on humans fortunately occur rarely. WS-Wyoming did not respond to any incidents during FY14-18 involving people attacked and/or injured by large carnivores, but this is not because attacks did not occur. In Wyoming, WGFD is the primary response agency to large carnivore attacks, and WS-Wyoming only provides operational support for these incidents when requested. WS-Wyoming has assisted WGFD in responding to large carnivore attacks in the past. WS-WY has also responded to complaints involving black bears and grizzly bears which were perceived as threats to public safety, where no attacks were documented. WS-Wyoming might recommend exclusion and/or harassment methods to reduce human health and safety concerns, but the offending animals are often lethally 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 Wyoming and nationwide.

Pets 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 FY14-18, WS-Wyoming documented $140 in annual losses to pets due to predators. Most of these economic losses were caused by mountain lions and coyotes (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 (White and Gehrt 2009, Gese et al. 2012, Poessel et al. 2013). 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 (White and Gehrt 2009, Baker and Timm 2017). Some of the same investigators reported on the role pets may play in coyote attacks on humans (White and Gehrt 2009, Poessel et al. 2013). 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 (White and Gehrt 2009, Poessel et al. 2013). 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 were 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 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 FY14-18, WS-Wyoming investigated one report of a bear in close proximity to a town. WS-Wyoming Specialists did not respond to any instances of black bear attacks or aggression towards humans but could do so at the request of WGFD.

1.17.4.4 What is the Extent of Human Cougar Interactions

Potentially 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. 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) reported 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 (California Department of Fish and Wildlife 2017).

WS-Wyoming Specialists did not respond to any human safety incidents involving mountain lions during FY14-18, but has done so in the past, and could in the future at the request of WGFD.

1.17.4.5 What is the Extent of Human Grizzly Bear Interactions?

Six people have been killed by grizzly bears in Wyoming in the last ten years, including the most recent fatal attack which occurred in Teton County in 2018. Prior to this the most recent fatal attack in Wyoming occurred in August of 2015 in Yellowstone National Park. Usually one of two circumstances are present when an injurious or fatal human grizzly conflict occurs. Herrero and Fleck (1990) reported that sudden encounters with grizzly bears, particularly in off-trail areas, and food-conditioning and habituation are evident in most injurious or fatal human-grizzly bear encounters.

Many of the human-grizzly bear interactions in Wyoming have occurred in Yellowstone National Park and surrounding National Forests in areas used for recreation (e.g. camping and hiking). In 2008, 3.07 million people visited Yellowstone National Park (National Park Service 2019). In 2018, this number had increased to 4.12 million (YNP 2019), a 34% increase. There were an estimated 596 grizzly bears in the GYE in 2008 (Interagency Grizzly Bear Study Team 2008) By 2018, the estimated population had increased to 709 (Interagency Grizzly Bear Study Team 2019), a 19% increase. State and federal agencies have made great strides in educating the public on the importance of food security and not feeding grizzly bears, as evidenced by Bear Wise Wyoming (https://wgfd.wyo.gov/bear-wise-wyoming). However, the increased presence of humans in undeveloped areas coupled with the increasing population of grizzly bears could lead to an increase in the number of injurious or fatal human-grizzly bear encounters.

During FY14-18, WS-Wyoming investigated one report of a bear in close proximity to a town. WS-Wyoming Specialists did not respond to any instances of grizzly bear attacks or aggression towards humans in Wyoming but could do so at the request of WGFD.

1.17.4.6 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.

1.17.4.7 What Work is needed to Protect Air Operations from Ground Predators at Wyoming 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. 2004, 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 (GAV) 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. 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-Wyoming Assistance to WGFD, USFWS, and others for Natural Resources Protection?

Predators are sometimes responsible for damage to natural resources, including threatened and engendered (T&E), sensitive, and game species. In FY14-18, WS-Wyoming responded to an annual average of 28 incidents of predator damage or threats to natural resource. Most of these responses (67%)

were to protect mule deer and white-tailed deer from predation by coyotes. WS-Wyoming also responded to requests to protect sage grouse from predation by badgers and coyotes and pronghorn from predation by coyotes and red foxes.WS-Wyoming also responded to requests to protect standing trees from being girdled by porcupines. WS-Wyoming 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-Wyoming works with these agencies to identify and provide the level of protection needed. When such actions are requested by USFWS or another Federal agency, the responsibility for NEPA compliance rests with that agency. However, WS-Wyoming 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. 2009), 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 Jr. 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 affecting 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 (Theberge and Gauthier 1985, Hurley et al. 2011, Forrester and Wittmer 2013).

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, hunter harvest, vehicle collision or malnutrition/disease mortality are often the largest causes of death in ungulate populations, especially mule deer (Bishop et al. 2009, Hurley et al. 2011, Sawyer et al. 2012, Brodie et al. 2013, Forrester and Wittmer 2013). 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 (Latham et al. 2013, Leblond et al. 2016b, Lehman et al. 2018).. Bishop et al. (2009) reached a similar conclusion about determining if mortality was additive or compensatory. 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 short term 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 (Bishop et al. 2009, Boertje et al. 2017). 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.

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	Years following low summer rainfall typically have decreased lagomorph and microtine abundance, resulting in increased predation by coyotes on deer fawns Years following high summer rainfall typically have increased lagomorph and microtine abundance, resulting in decreased predation by coyotes on deer fawns, due to increased availability of lagomorphs and microtines as coyote prey
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 ≥ 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 rainfall in the birth year of mule deer fawns can cause death from exposure and 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

Variable	Proximate factor	Ultimate factor
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 Doe body condition to survive birth and provide quality lactation Nutritional quality 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

1.17.5.2 Mule Deer Populations in the West

WS-Wyoming has been requested to reduce predation on several ungulate species over the years. Mule deer are the species WS-Wyoming would most likely be requested by state or federal wildlife management agencies to conduct PDM activities to minimize or decrease the effects of predation on mule deer, 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-1970s. 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 (Ballard et al. 2001, Hurley et al. 2011, 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 predator control 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 has no effect on mule deer populations, and mountain lion and coyote predation was compensatory rather than additive, with possibly one study being additive. Forrester and Wittmer (2013) review of population dynamics of mule deer only found 6 studies that reported vital rates for the studied mule deer population and where predators were removed.

Ballard et al. (2001) reviewed mule deer – predator relationships, and found predation by coyotes, mountain lions or wolves may be significant mortality factors under some conditions. They determined predation could only be identified as a major limiting factor of 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). The 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 exists for PDM to increase moose, caribou and one black-tailed deer population. 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 are 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. (2016a), 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. 2016a)* 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 and gray wolves no longer have spatial summer separation from caribou resulting in new and increased mortality and caribou population decline. Leblond et al. (2016a) 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. 2016b). 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).

Hurley et al. (2011) examined the effects of removing coyotes and mountain lions to increase the survival and population growth rate of mule deer on two study sites in Idaho. Their study also took into account the effects of other variables, such as lagomorph abundance and climactic conditions. The results of their study indicated removing coyotes was most effective in decreasing fawn mortality when deer were being utilized by coyotes as an alternate prey source (i.e. when lagomorph populations were reduced). They also found over-winter mortality of adult female mule deer decreased with removal of mountain lions. The study was unable to detect a strong effect of coyote or mountain lion removal alone on the mule deer population trend, highlighting the variation in mule deer survival and population growth rates is attributable to multiple variables simultaneously influencing these parameters. Hurley et al. (2011) concluded that the benefits of predator removal appeared to be marginal and short term on their study sites and removal of coyotes and mountain lions is not likely to change long-term dynamics of mule deer population in the intermountain west.

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, depending on the ecological context of the deer population (Table 1-9). These patterns are useful to make preliminary judgments whether an ungulate population is subject to population declines caused ultimately by predation. Further analysis or small research projects could supplement the feedback pattern to determine if a larger scale research or management action is warranted.

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

Feedback Pattern	Parameters	Conditions
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.		

1.17.5.4 Mule Deer Populations in Wyoming

Over thousands of years, mule deer have evolved physical adaptations to cope with Wyoming's harsh climates and their populations fluctuate naturally in response to environmental variables. In Wyoming, mule deer were generally uncommon in the 19th and early 20th centuries, then their populations increased and reached their maximum abundance across the west during the 1950's and 60's. The high deer densities of the 50's and 60's were likely unsustainable, and since the 1970's there has been a general declining population trend in Wyoming. In 1991, about 578,000 mule deer inhabited the state, by comparison, in 2018 the mule deer had declined 38% to an estimated 360,000 animals. Wyoming manages their mule deer based on a "herd unit" concept. There are 37 recognized mule deer herds in the state (Figure 1-5). A herd is a distinct population with limited interchange with other herds and typically remain in certain geographic regions, and use traditional birthing areas, summer habitats, migration corridors and winter ranges from year to year. Herd sizes vary from a few hundred, to tens of thousands in the largest herds. In 2007, The WGFC responded to the declining mule deer populations by adopting the Wyoming Mule Deer Initiative (WMDI) with the intent to identify the most pressing issues that are affecting Wyoming's mule deer and develop individual management plans for key populations (Mule Deer Working Group 2018)

The WMDI evaluates a number of variables that have influenced the decline of mule deer in Wyoming including: Altered fire intervals, invasive plants, fragmented habitat, climatic extremes, competition with other wildlife species, predation, hunting frameworks, disease, and increased use of All Terrain Vehicles.

Each herd has specific variables influencing the health of the herd and the WMDI identifies these needs with the intent to develop individual management plans for each herd.

One area of particular concern and identified as a top priority for a management plan according to the MDI, was the Wyoming Range mule deer population in western Wyoming. The Wyoming Range mule deer is one of the largest herds in the world and its population has undergone changes in recent decades from a high of >50,000 in the late 1980s, to a population of ~30,000 during much of the last decade.

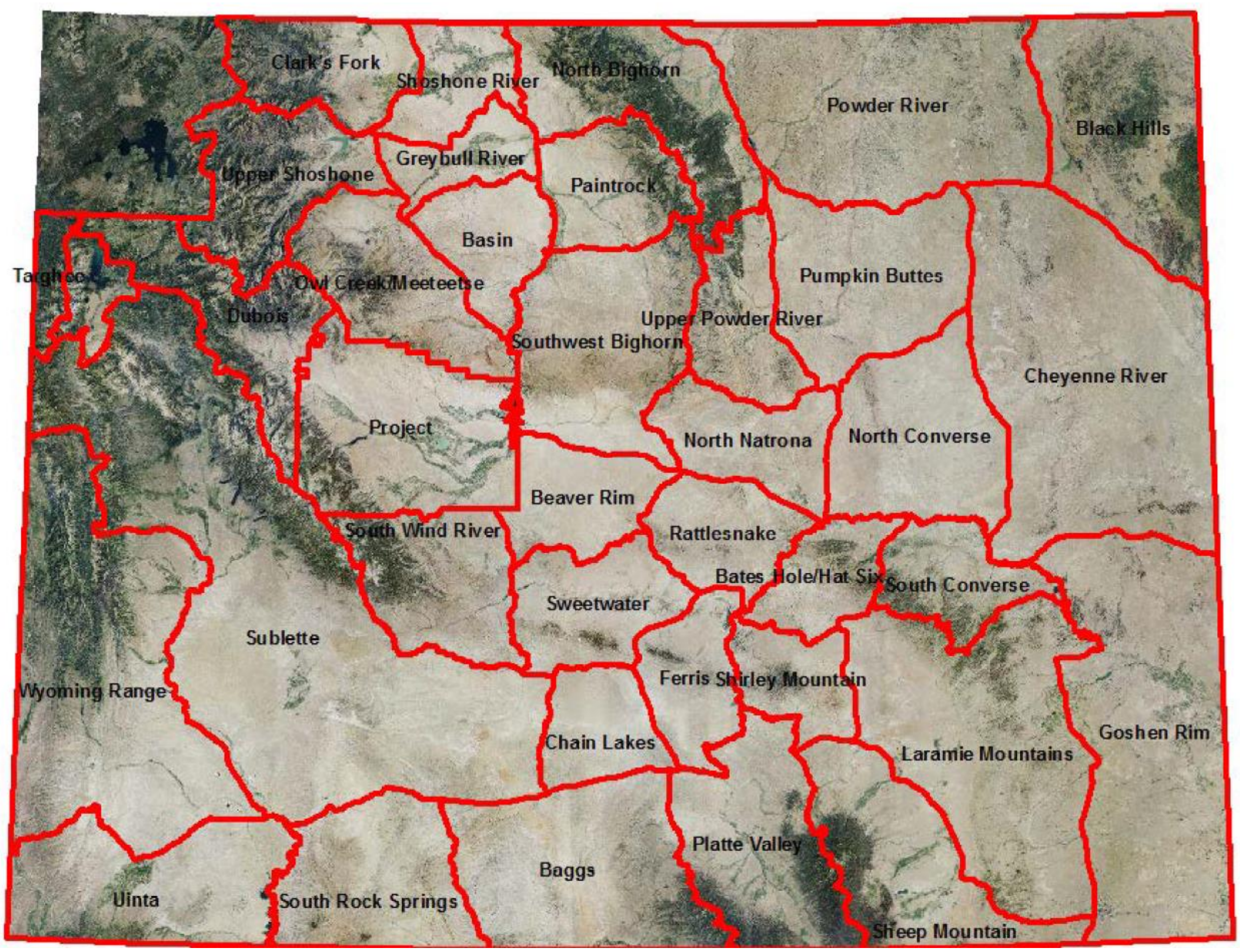

Figure 1-5. Wyoming mule deer herds (Mule Deer Working Group 2018).

From 2015-2017, 194 fawns from within the Wyoming Range were successfully tracked and their survival monitored. To evaluate cause-specific mortality, these fawns were tracked daily. When a mortality was detected, the fawn carcass was investigated immediately to ensure an accurate assessment of the cause of mortality. There was a breadth of various causes for fawn mortality including predation, disease, malnutrition, drowning, hypothermia, vehicle-collision, and just being caught in vegetation. In 2015, disease was the leading cause of death and accounted for 28% of all mortalities. The most prevalent disease was adenovirus hemorrhagic disease (AHD). AHD is a viral disease that can cause internal hemorrhaging and pulmonary edema. In 2016, predation was the leading cause of death for fawns with 38% of mortalities. 26% of mortalities in 2017 were because fawns were stillborn. This tied with predation as the leading cause of death for fawns in 2017 (Haub School of Environment and Natural Resources 2018).

One study in the Pryor mountains of Wyoming and Montana evaluated predation rates and prey composition by mountain lions (Blake and Gese 2016) The impacts of mountain lions on mule deer varies regionally but have been documented having profound impacts on certain mule deer populations. (Blake and Gese 2016) studied the relationships between mountain lions and their prey on the Pryor mountains, including bighorn sheep, mule deer, feral horses, and elk. Based on this study, there were 1,159 total mule deer and 67 total bighorn sheep within the study area. GPS collars were deployed on 6 adult mountain lions within the study area. Researchers visited the cluster GPS locations to determine predation rates and foraging patterns. Cougar kills were examined by prey species, sex and age class, prey-size class, season, and mountain lion sex.

Mule deer were the primary prey killed by mountain lions with (71.5% of kills), with bighorn sheep detected as the second highest frequency at 8%, followed by a single elk (.5%). Despite their presence in the study, no feral horses or livestock were killed by mountain lions. The remaining 20% of kills were a smaller prey-size class including coyote, raccoon, beaver, porcupine, pine marten, striped skunk, red fox, and a mallard. Blake and Gese (2016) found that female mountain lions killed more doe mule deer, while males killed more buck deer. Family groups (female lion with kittens) had the highest predation rates (the shortest time intervals between kills), while adult males had the lowest rate. The mean predation rates ranged from 6.01 ± 0.42 (± SE) to 8.24 ± 0.53 days between social classes of mountain lions.

Predator damage management 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. 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 correctly 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-Wyoming would work with WGFD, USFWS and other agencies when requested to participate in monitoring and research actions to determine appropriate management actions to meet population objectives.

Past research evaluating success of predator reduction to enhance ungulate populations has provided mixed results. Hurley et al. (2011) addressed coyote and mountain lion 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 and bear 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 2013).

The success of a project to control predators to increase a population of mule deer is dependent upon the deer population in relation to 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 (Bartmann et al. 1992). Conversely, if the population is below 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. 2005)

The impact of cougar hunting on cougar populations, especially high levels designed to suppress populations, can be varied and is not well understood. Anderson Jr. 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 Jr. 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.

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.

Previous studies have suggested that male survival is lower in hunted populations (Lambert et 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 Jr. and Lindzey 2005). 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 2009, 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). It is unclear how various levels of harvest could 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.

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. 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).

1.17.5.5 How are Pronghorn (Antilocapra americanna) affected by Predation?

Under certain conditions, predators, especially coyotes and mountain lions, can have a significant adverse impact on bighorn sheep and pronghorn antelope populations, and this predation is not necessarily limited to sick or inferior animals (Pimlott 1970, Shaw 1977, Bartush 1978, U.S. Fish and Wildlife Service 1978, Trainer et al. 1983, Hamlin et al. 1984, Neff et al. 1985). 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 Jr. (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.

1.17.5.6 How are Bighorn Sheep (Ovis Canadensis) Affected by Predation?

Bighorn sheep populations are 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. Rominger (2018) stated in his review of research conducted on predation of bighorn sheep that removal of mountain lions might be required, when mountain lion-ungulate ratios are high, to protect small or endangered bighorn sheep populations, and to produce bighorn sheep for restoration efforts. 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 is used to protect desert bighorn sheep, which are on the NM State endangered species list (New Mexico Game and Fish Department 2010).

1.17.5.7 Predation on Nesting Upland Gamebirds, Waterfowl, and Shorebirds

WS-Wyoming received requests from WGFD between FY14 and FY18 to provide protection for nesting upland gamebirds from predators. No requests were received from WGFD or other agencies to provide protection from predators for waterfowl and shorebirds. However, APHIS-WS does conduct PDM projects in several other parts of the U.S. to protect nesting birds that are federally listed T&E species, and similar assistance could be requested of the WS-Wyoming program in the future. For example, WS conducted PDM for Attwater's greater prairie-chickens in Texas (U.S. Fish and Wildlife Service 1998) where nest predation by skunks, coyotes, and other species was identified as a limiting factor in their recovery. Avian species that are federally listed in Wyoming and that could be impacted by predators include: the least tern (endangered), piping plover (threatened), and yellow-billed cuckoo (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 Wyoming 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 2016, 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 predator damage management 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. 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. Presnal 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.

Habitat losses remains the greatest cause of greater sage-grouse population declines (Connelly et 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 II 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). While 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 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 sage brush 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.

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. Nohrenberg (1999) investigated the effects of limited predator removal on pheasant populations on his study areas in southern Idaho and found consistently higher pheasant survival and productivity in predator removal areas as compared to similar non-removal areas.

Thomas (1989) and Speake et al. (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. In a study conducted in the Black Hills of Wyoming Cahoy (2009) reported 22% of mortality of male wild turkeys was attributable to predation. 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. Lehman et al. (2008) reported the majority (89%) of wild turkey nest failures in their study in the Black Hills of South Dakota were attributed to mammals. In instances where hair evidence could be collected coyotes were the most common cause of nest predations.

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, Bandy Jr. 1965, Urban 1970). 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 predator damage management, 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. (1995) 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 (U.S. Fish and Wildlife Service 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.

1.17.5.8 Other Species

WS-WY 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-Wyoming could assist in determining if PDM efforts could help protect these species and implement any appropriate PDM actions to address it. Species being given protection often are T&E species or species of special conservation status at the state level. Black-footed ferrets and Canada lynx are two federally listed T&E species in Wyoming that are impacted by predators.

1.17.5.9 Beneficial Impacts to Native Wildlife from Livestock Protection Programs

Some people want to know about collateral benefits to wildlife populations from WS-Wyoming conducting livestock protection programs. These benefits are difficult to measure because WGFD measures populations by management units, regions, 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 (Hurley et al. 2011, Forrester and Wittmer 2013, Monteith et al. 2014). 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. No single damage management method – nonlethal or lethal – is appropriate for every situation or predator species (Scasta and Windh 2017). 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-Wyoming's 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-Wyoming policy is not to cause population-wide or even localized long-term adverse impacts to the target species' populations (unless to meet WGFD 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. WGFD and WDA 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 is 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 (Office of the Inspector General 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 indiscriminate 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 indiscriminate 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 (Government Accountability Office 2017). At the request of Congress, the GAO conducted a review of the APHIS-WS' PDM program in 2001 (General Accounting Office 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 (General Accounting Office 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-Wyoming 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).

Recent studies have criticized certain research on lethal PDM methods and recommend suspension of these tools until more rigorous scientific studies prove their efficacy. These researchers call for new study designs that use the same standards as those in controlled laboratory settings for biomedical research. NWRC research scientists have evaluated these papers and do not agree with the authors' assessments that existing research is flawed (USDA Animal and Plant Health Inspection Service 2016) . 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 that cannot be controlled. Assumptions must be made when trying to answer complex ecological questions in field settings. Scientists address and acknowledge these variabilities using well-established and recognized field study designs, such as the switch-back and paired block designs.

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.

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. 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.

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 and 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-Wyoming 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 (Office of Management and Budget 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 (NED) 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 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*" (U.S. Army Corps of Engineers 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 (Natural Resources Conservation Service 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 of these factors. 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 and Grant 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 General Accounting Office (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 General Accounting Office (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 and Grant 2010, Loomis 2012)(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 Merell (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 (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 available 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 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 the 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 do 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 requires professional assistance in designing, executing, and documenting their surveys. These requirements make it very difficult and expensive to conduct public surveys.

1.19.5 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.

1.19.5.1 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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 (Internal Revenue Service 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.

1.19.5.2 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).

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

The Agriculture Improvement Act of 2018 (aka the 2018 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. Grizzly bears are the only species considered in this EA that is 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.

1.19.5.3 Livestock Producers Should Pay All Costs of PDM

The Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426) 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 Act was amended in 1987 (Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. 426c)) 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."

The Act of March 2, 1931 (46 Stat 1468), 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 Wyoming, this funding is made up of about 62% from PMBs (this includes funding from private sources, such as brand inspection fees), 35% from Congressional appropriations, 3% from state interagency agreements, and <1% from private or commercial cooperators. Cooperators pay the costs of non-lethal actions taken, even when recommended by WS-Wyoming personnel, and a substantial proportion of the cost for WS-Wyoming efforts, including WS-Wyoming administrative overhead.

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

1.19.5.4 A Program Subsidizing Nonlethal 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-Wyoming may rarely loan harassment equipment on very limited circumstances. The State of Wyoming also provides no subsidies.

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

1.19.5.5 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.

1.19.5.6 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-Wyoming ultimately decides when it is appropriate to enter into agreements with WGFD to assist with meeting state game management objectives.

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

1.19.5.7 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 Wyoming, the primary responder to damage caused by dogs is either a local animal control authority, county sheriff's department, or any other peace officer. However, WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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.

1.19.5.8 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. 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming. Though not specifically required by NEPA or CEQ, this is an essential issue for the WS-Wyoming 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 and predatory animal species targeted by WS-Wyoming during PDM: coyote, raccoon, striped skunk, red fox, badger, feral cat, white-tailed jackrabbit, black-tailed jackrabbit, porcupine, bobcat, Virginia opossum, black bear, mountain lion, feral dog, mink, grizzly bear, western spotted skunk, eastern spotted skunk, long-tailed weasel, and short-tailed weasel. 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-Wyoming 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-Wyoming to be potentially impacted by WS-Wyoming's PDM activities. Other non-target species discussed are those recently taken by WS-Wyoming 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 be 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 the population of any given species; however, impacts on wildlife populations are included in this analysis to the extent that they may affect the ecosystem. Effects on populations of individual species 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-Wyoming 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-Wyoming employees to zoonotic diseases from handling wild animals
- Potential for WS-Wyoming employees, the public, or surface water to be exposed to hazardous chemicals (*e.g.*, lead, pesticides, immobilizing/euthanasia chemicals, and pyrotechnics)
- Potential for WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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 (1989b) 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” (California Department of Fish and Game 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” (American Veterinary Medical Association 1987). Suffering implies a duration of time; thus, an animal would experience “little or no suffering where death comes immediately” (California Department of Fish and Game 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 (California Department of Fish and Game 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” (American Veterinary Medical Association 2013a). 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” (American Veterinary Medical Association 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 life 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 (American Veterinary Medical Association 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*" (American Veterinary Medical Association 2013a). 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.*" (American Veterinary Medical Association 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 1994, Kellert and Smith 2000) (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 (Littin et al. 2004, Haider and Jax 2007). 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 1985;1994).

A recent study by (George et al. 2016) replicated the research of (Kellert 1985) 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 1989a).

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 1989a). 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, a utilitarian version of sentientism, 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 population crashes due to exceeding the environmental carrying capacity (Varner 2011). 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 it is 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 WGFD 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 The removal of coyotes by WS 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, WS is unaware of any data that would substantiate the speculation (Connolly and Longhurst 1975) 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 (General Accounting Office 1990) which concluded that “according to available research, localized lethal controls have served their purpose in reducing predator damage (General Accounting Office 1990).

2.3.3 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 79% of predation and injuries reported to WS-Wyoming occurs to young livestock (lambs, kids, and calves). 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 collecting federal tax deductions for predation losses.

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

Public comments to prior PDM EAs have raised the concern that the mere presence of WS-Wyoming 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-Wyoming personnel spend in any particular area. There are fewer than 20 WS-Wyoming field personnel in Wyoming, 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-Wyoming 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 disturbance is of particular concern. In general, few if any such concerns have been raised by the responsible agencies because WS-Wyoming personnel only work on a small proportion of the land area and spend little time in any particular area.

2.3.5 Concerns that WS Employees Might Unknowingly Trespass

Public comments to prior PDM EAs have raised the concern that WS-Wyoming employees could trespass onto private property or across State boundaries both on the ground and in the air. WS-Wyoming is aware that it is sometimes difficult to determine land ownership and boundary lines, and WS-Wyoming 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-Wyoming typically provide WS-Wyoming 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-Wyoming aerial PDM activities are typically conducted with the aerial crew in radio contact with a WS-Wyoming representative on the ground who knows the property boundaries of the area being worked. Field staff and the aircraft often have GPS units or smart phones loaded with property maps to aid in identifying ownership of property being worked on the ground. Therefore, we do not expect that inadvertent trespass incidents would rise to the level of presenting any significant environmental effects.

2.3.6 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 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-Wyoming uses the best available data and information from wildlife agencies having jurisdiction by law (WGFD 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).

2.3.7 Concerns that Killing Wildlife Represents "Irreparable Harm"

Public comments to prior PDM EAs 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-Wyoming 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, in spite of liberal hunting seasons and the killing of hundreds or thousands of these animals annually. The legislated responsibility of WGFD is to provide "an adequate and flexible system for the control, propagation, management, protection and regulation of all Wyoming wildlife". Therefore, WGFD 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-Wyoming takes in PDM actions are expected to sustain viable populations. Thus, losses due to human-caused mortality are not "irreparable".

2.3.8 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 (U.S. Environmental Protection Agency 2013), as temperatures continue to increase, the ranges of many species are expanding 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 the range and abundance of numerous species. 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 Wyoming. Because these types of changes are an ongoing process, this EA has developed a dynamic system including mitigations and standard operating procedures (SOPs) that allow the agencies to monitor for and adjust to impacts of ongoing changes in the affected environment. WS-Wyoming 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-Wyoming 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. 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-Wyoming that could jeopardize the long-term viability of WS-Wyoming actions on wildlife populations. Monitoring would include review of federally listed T/E species and consultation with the USFWS, as appropriate. Implementation of conservation measures related to avoidance and protection would be anticipated to result from consultation, as necessary, and therefore, reduce or avoid adverse impacts to T/E species and their designated critical habitats.

As with any changes in need for action, WS-Wyoming 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 and is responsive to ongoing changes in the cumulative impacts of actions conducted in Wyoming 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 (Council on Environmental Quality 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 (Council on Environmental Quality 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 CO2, NOx, CO and SOx) annually (U.S. Environmental Protection Agency 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 U.S. Environmental Protection Agency (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 Wyoming 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 (Federal Highway Administration 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 U.S. Environmental Protection Agency (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 CO2 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.

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 CO2 emissions (Conklin and de Decker Associates 2017). APHIS-WS also owns or leases six different types of fixed wing aircraft. Average CO2 emissions from these types of aircraft is 0.11MT/hour (Conklin and de Decker Associates 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 CO2 emissions would be 1,612 MT/year. If all flight hours were attributed to helicopters, the estimated CO2 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 (Council on Environmental Quality 2014). These are cumulative data for APHIS-WS nationwide. WS-Wyoming produces only a small proportion of these emissions, and the WS-Wyoming PDM activities analyzed in this EA produce an even smaller portion.

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-Wyoming 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.

2.3.9 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-Wyoming 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 WP.

2.3.10 Accuracy of Reporting Take of Target and Non-target Animals:

Commenters have questioned the accuracy of recordkeeping by APHIS-WS 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 permit requirements, 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 (Office of Inspector General 2015). The audit concluded that APHIS-WS was generally in compliance with all applicable laws. Of almost 30,000 entries in the MIS, 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-Wyoming operations, based on previous PDM EAs prepared in the Western United States and in Wyoming. They will not be discussed further in this EA.

- ***Water Quality and Aquatic Resources:*** WS-Wyoming operations do not involve construction, major digging, dredging or filling, discharge of pollutants into waters of the U.S., or changes to flow of waterways. All chemicals used for PDM are used, stored and disposed of in accordance with EPA and state requirements for the protection of the environment. WS activities would not cause erosion or sedimentation into water bodies. See also general soils and vegetation in this section. Therefore, PDM would not affect water resources including water quality and wetlands, streams, ponds, or other waterbodies.

- ***Floodplains (E.O. 11988):*** WS-Wyoming 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-Wyoming operations do not change the visual quality of public sites or areas. Although physical structures may be recommended as part of technical assistance, they are not constructed by WS-Wyoming and therefore not under the agency's jurisdiction.
- ***General soils*** (except for Issue E: lead contamination from the use of lead ammunition): WS-Wyoming 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-Wyoming 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-Wyoming operations do not involve permanently converting the land use of any kind of farmlands or other unique areas.
- ***Air quality:*** WS-Wyoming's emissions are from routine use of trucks, ATVs, airplanes, etc., and therefore constitute a *de minimis* contribution to criteria pollutants regulated under the Clean Air Act (See Section 2.3.8 for discussion of climate change).
- ***Vegetation***, including timber and range plant communities: WS-Wyoming 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-Wyoming PDM activities. All WS-Wyoming PDM activities are conducted under the authorization of and in compliance with federal and state laws and in coordination with WGFD, WDA, 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, in both cases, 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-Wyoming PDM program. They are described in Sections 2.6-2.9 below. These alternatives address WS-Wyoming PDM activities only. For other APHIS-WS and WS-Wyoming NEPA documents, including those open for public comment, please see: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/programs/nepa/SA_Environmental_Assessments+%28EA%29/SA_WS_Environmental_Assessments_State.

The alternatives considered in detail are:

- Alternative 1 - Proposed Action/No Action Alternative - Continue WS-Wyoming PDM Program
- Alternative 2 - Lethal PDM Methods Used by WS-Wyoming Only for Corrective Control.
- Alternative 3 – WS-Wyoming Provides Technical Assistance Only
- Alternative 4 – No WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming Field Personnel Select a PDM Strategy Using the APHIS-WS Decision Model?

For all alternatives in which WS-Wyoming provides requested services, WS-Wyoming uses the APHIS-WS Decision Model (Figure 2-1; 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 cooperating agencies for this EA. To use an analogy, it is 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming field specialist makes a determination as to whether the assistance request falls within the authority of WS-Wyoming. 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-Wyoming 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-Wyoming 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-Wyoming field specialist provides recommendations and/or advice to the requester. A direct operational assistance project normally ends when a WS-Wyoming 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-Wyoming 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 (Slate et al. 1992, USDA Wildlife Services 2014b).

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-Wyoming, 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-Wyoming 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 by predators or scavengers, natural decomposition, and local climate variables, can impact the condition of the livestock remains and make it harder for WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming program is to resolve and prevent damage caused by predators and to reduce threats to human safety. To meet this goal, WS-Wyoming responds to requests for assistance with technical assistance and/or operational assistance to entities that enter into an agreement with WS-Wyoming. 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. Additionally, landowner and livestock producer tolerance of damaging species is greatly eroded if damage continues to occur. As such, WS-Wyoming works closely with those requesting entities to identify situations where damage is likely to occur, and WS-Wyoming personnel implement or recommend effective methods as early as possible.

WS-Wyoming 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-Wyoming Perform PDM Activities Under Alternative 1?

The current WS-Wyoming 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-Wyoming PDM program are described below. The specific methods are described in detail in Appendix A.

Collaboration and Project Identification

WS-Wyoming 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-Wyoming 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-Wyoming's technical assistance recommendations on their own, use contractual services of private businesses, use volunteer services of private organizations, use the services of WS-Wyoming (operational assistance), take the management action themselves, or take no action.

Operational Assistance

WS-Wyoming 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-Wyoming to conduct PDM activities on their behalf, WS-Wyoming employees will provide these services whenever they are legal, warranted, safe, and effective. When WS-Wyoming employees conduct PDM activities, whether non-lethal or lethal, this is considered Operational Assistance. In most cases, WS-Wyoming provides a combination of technical assistance and operational assistance. Often, non-lethal recommendations provided by WS-Wyoming are conducted by the resource owners, because it is logistically or economically more practical. These same resource owners may contract with WS-Wyoming to conduct lethal PDM, because they find it to be safer, more effective, and/or more cost-efficient.

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 USDA Wildlife Services (2017b):

"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-Wyoming 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-Wyoming 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-Wyoming 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 USDA Wildlife Services (2017b):

"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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming does not bury carcasses taken during land-based operations. Unless otherwise regulated by Wyoming law, WS-Wyoming 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-Wyoming, in coordination with WGFD 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-Wyoming determines if any additional information that arises subsequent to the NEPA decision from this EA would trigger the need for additional NEPA analysis. WS-Wyoming 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-Wyoming 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-Wyoming activities on specific target predator and non-target wildlife populations. WS-Wyoming provides detailed information on animals removed, as appropriate, to WGFD to assist with managing species and resources under their jurisdiction.

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

WS-Wyoming 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.

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-Wyoming 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-Wyoming personnel under the Decision Model as described earlier (Section 2.6.2, Figure 2.1). WS-Wyoming 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-Wyoming may include habitat management, husbandry, hazing, fencing, fladry, aversive/harassment devices, herding, moving livestock, range-riders, and livestock guard animals (Appendix A). WS-Wyoming may occasionally loan harassment equipment such as propane cannons, fladry and pyrotechnics to citizens experiencing depredations. Fladry has reduced livestock depredation by some predator species but has not been proven effective in preventing loss due to coyotes (Davison-Nelson and Gehring 2010).

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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming operational assistance with PDM is requested, it is generally 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-Wyoming 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-Wyoming employees follow the American Veterinary Medical Association (American Veterinary Medical Association 2013a) 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.

Aerial PDM is conducted only on lands where it is authorized and when under agreement. 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 WDA to remove coyotes and foxes for the protection of wildlife, livestock, or health.

The current WS-Wyoming program is or may be conducted on private, public, tribal, and other lands where a request has been made, the WS-Wyoming 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.

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

Upon receiving a request from a farmer, livestock producer, or livestock association, WS-Wyoming uses the WS Decision Model to determine the best course of action. If operational assistance is warranted, WS-Wyoming 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-Wyoming Use Predator Damage Management to Protect Aircraft and Air Passengers from Wildlife Hazards?

Upon receiving a request for assistance from an airport authority, WS-Wyoming can provide a variety of services, including assessing the situation, developing an operational plan, and assistance with implementation of the plan. WS-Wyoming 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 Wyoming Bird Damage Management EA (USDA Wildlife Services 2008). This EA covers WS-Wyoming 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-Wyoming at airports, with the exception of aerial PDM, which would produce a safety hazard.

WS-Wyoming personnel also provide ongoing technical advice and training 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.

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

Under Alternative 1, WS-Wyoming 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 WGFD). 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-Wyoming 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 Sage-Grouse:

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

2.6.9.2 Protection of Black-footed Ferrets:

WS-Wyoming could be asked for assistance with protecting federally endangered black-footed ferrets from predation in reintroduction areas in the future.

2.6.9.3 Protection of Mule Deer:

WS-Wyoming has been requested by WGFD to reduce predation on several ungulate species over the years. Currently, the most likely requests would be to protect mule deer, if predation was determined to be limiting population maintenance or growth. WS-Wyoming may also conduct PDM for research projects to assess the effect of predator control on mule deer or other ungulates.

2.6.9.4 Protection of Pronghorn and Bighorn Sheep

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 Wyoming is a decision which rests with WGFD; WS-Wyoming may assist WGFD at their request. In such cases, WS-Wyoming will use those PDM strategies which would likely be effective and successful (Ballard et al. 2001). However, as the management agency, WGFD would determine when and where PDM would be conducted. WS-Wyoming has been asked by WGFD to protect pronghorn and bighorn sheep populations from predation in the past and could be asked to do so again in the future, if predation is identified as a limiting factor. WS-Wyoming would provide assistance with PDM in these situations whenever WS-Wyoming determined it to be warranted and effective.

2.6.9.5 Protection of Nesting Upland Gamebirds, Waterfowl, and Shorebirds

WS-Wyoming has a special use permit with the WGFC to conduct specific predatory animal control on Wildlife Habitat Management Areas owned by the WGFC that are under an Agreement for Control of Animal Damage on Private/Non-Private Property. This allows WS-Wyoming staff to respond to requests from WGFD staff to implement PDM activities for the benefit of nesting upland gamebirds, waterfowl or shorebirds, along with a variety of other wildlife species. WS-Wyoming has also responded to requests for PDM for the protection of the greater sage-grouse. APHIS-WS 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-Wyoming program in the future. For example, APHIS-WS conducted PDM for Attwater's greater prairie-chickens in Texas (U.S. Fish and Wildlife Service 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 Wyoming and that could be impacted by predators include: the least tern (endangered) and piping plover (threatened). Additional support may be given to these species should it be determined by an agency with management authority over such species that predation 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 nesting adults 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, namely raccoons, skunks, red foxes, badgers, opossums and coyotes.

2.6.10 How Does WS-Wyoming 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-Wyoming uses the WS Decision Model to determine the best course of action. If operational assistance is warranted, WS-Wyoming develops an operational plan, and implements the plan. WS-Wyoming 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-Wyoming Action and Why Are Their Action 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 (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-Wyoming takes several species of predators and predatory animals (see Section 3.1) which damage or threaten human property or safety and natural resources. In the absence of WS-Wyoming 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-Wyoming'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" Council on Environmental Quality (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-Wyoming 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.

State agencies also have legal authority to respond to and manage wildlife conflicts. As discussed in Chapter 1, WGFD and WDA have legal wildlife damage management authority, and these agencies issue depredation permits and permits for aerial PDM, respectively. For species classified as predatory animals in Wyoming, property owners can remove such animals causing depredation or damage without a permit. Other species can often be taken with a permit issued by WGFD or without a permit if caught in the act of causing damage to livestock, depending on the species. In addition, WGFD 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, PMBs, or WGFD to provide PDM services, or authorize another person(s) to remove damaging species. Per Wyoming statute [WS § 23-3-103], anyone may take animals defined as predatory animals [WS § 23-1-101(viii)] without a license, in any manner, and at any time. Wyoming statute also allows any black bear, mountain lion, bobcat, weasel, or badger doing damage to private property to be taken immediately by the owner of the property, employee of the owner, or lessee of the property [WS § 23-3-115]. Coyotes and red foxes may be taken by private individuals through aerial PDM with a permit from WDA and permission from the landowner.

Federal, State, commercial, and private entities receive authorization to conduct PDM from the WGFD and WDA and most methods for resolving predator damage are available to both WS-Wyoming and to non-federal entities. Under all alternatives, including those in which WS-Wyoming 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-Wyoming entities.

2.7 Alternative 2 – Lethal PDM Methods Used by WS-Wyoming Only for Corrective Control

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

This alternative differs from Alternative 1 in that WS-Wyoming field personnel would not directly provide any lethal operational assistance for preventive control, even if contracted as an agent of WGFD. WS-Wyoming might recommend preventive lethal PDM, but cooperators would be dependent on contracting assistance from commercial companies, pilots with state aerial shooting permits, or WGFD or their agents for their lethal PDM responses, or conduct the actions themselves, as allowed by state law.

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-Wyoming. Private individuals can obtain permits from WDA to perform these activities.

WS-Wyoming 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-Wyoming Provides Technical Assistance Only

Under Alternative 3, WS-Wyoming would provide both non-lethal and lethal technical assistance, similar to Alternatives 1 and 2. However, WS-Wyoming would provide no operational assistance, including non-lethal and lethal methods. All operational PDM in Wyoming 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 on federal lands, because they are approved only for use by APHIS-WS on federal lands. It would also limit the use of other methods such as aerial PDM.

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-Wyoming 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-Wyoming may provide supplies or materials for non-lethal methods that are of limited availability for use by private entities, such as fladry or propane cannons. Generally, WS-Wyoming 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-Wyoming could implement those recommended methods, could use other lethal and non-lethal methods not recommended by WS-Wyoming, could seek assistance from other entities, or take no further action. WS-Wyoming 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-Wyoming would not conduct operational lethal PDM. Many cooperators rely on these services from WS-Wyoming 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-Wyoming. 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-Wyoming 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-Wyoming PDM Program

Under this Alternative, WS-Wyoming would not be involved in any PDM efforts in Wyoming. PDM would still be implemented by other legally authorized entities, such as WGFD, USFWS, property owners, commercial PDM companies, PMBs, 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-Wyoming.

WS-Wyoming would not provide assistance with any aspect of managing damage caused by predators in Wyoming, 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 WGFD, University of Wyoming Extension Service offices, or pest control companies. Currently, WGFD only provides direct WDM assistance in limited situations (primarily trophy game species) 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-Wyoming would be redirected to these entities.

2.10 What Alternatives Are Not Considered in Detail?

Several alternatives have been considered by WS-Wyoming 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-Wyoming, 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-Wyoming reviewed alternatives and ideas considered by WS-Wyoming 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 comes 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-Wyoming program currently requests cooperative local government or private funding to cover between 60 and near 100% of the program's costs for services, which makes it, in essence, "fee based" to a relatively 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-Wyoming

Under such an alternative, WS-Wyoming 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-Wyoming 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-Wyoming provides technical assistance only. For an assessment of the "only non-lethal direct assistance by WS-Wyoming", 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-Wyoming

Under this alternative, WS-Wyoming would only provide technical and operational assistance using lethal PDM techniques. Prohibiting WS-Wyoming 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 (Gehring et al 2010). 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-Wyoming 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-Wyoming would provide only non-lethal technical assistance and non-lethal operational assistance. WS-Wyoming 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-Wyoming specialist would not also provide professional advice regarding effective lethal methods that are legal for the requester to use in Wyoming. 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-Wyoming Verifies that Reasonable Non-lethal Methods are Used Before Implementing or Recommending Lethal Operations

Under this Alternative, WS-Wyoming 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-Wyoming would take lethal action.

This alternative would preclude lethal preventive assistance conducted by WS-Wyoming, because assistance would not be taken until WS-Wyoming 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-Wyoming 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 require 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-Wyoming assistance with lethal PDM methods;
- Employees of WS-Wyoming 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-Wyoming 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, through county predator boards, or through commercial companies. WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming employees.

2.10.7 WS-Wyoming 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 all 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-Wyoming 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. APHIS-WS has no authority to establish a bounty system for population control, suppression, or extirpation, which falls to the states. 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 confirmed damage caused by black bears, grizzly bears, mountain lions, wolves (in the trophy game management zone), big game animals, and game birds, shall be paid by WGFD in accordance with WS 23-1-901 and WGFC Chapter 28 Regulation. APHIS-WS has no legal authority or jurisdiction to provide for financial compensation for losses. Grizzly bears are the only predator in this EA that are covered by compensation allowances under the Agriculture Improvement Act of 2018 (a.k.a., the 2018 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-Wyoming 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-Wyoming policy is to respond regardless of the requester's threshold of loss.

Therefore, this alternative is not considered in detail.

2.10.11 Use of Regulated Hunting and/or Trapping to reduce Predator Damage

WGFD can and has used regulated hunting by private individuals as an effective population management tool in areas where species classified as trophy game to reduce damage potential. State-sponsored hunting and 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 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-Wyoming would be translocated. In accordance with state law, translocation of bears, mountain lions, and other predators must be approved by WGFD. Therefore, the translocation of these predators by WS-Wyoming would only occur as directed by WGFD and/or as authorized by state law.

A permit from WGFD is required to translocate most wildlife species in Wyoming. With the exception of black bears, grizzly bears, and mountain lions, WGFD generally does not permit the translocation of most predators they have authority for, 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, unfamiliarity with the new location or time of year. Many smaller predators causing conflict are relatively abundant, such as coyotes, skunks, and raccoons. Others are not native, such as feral cats and dogs.

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-Wyoming could be requested and authorized by WGFD to translocate problem black bears, grizzly bears, or mountain lions, as a component of any alternative that includes an active WS-Wyoming 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 (2001b;2001a) 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 2001a). 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 their study, Bromley and Gese (2001b;2001a) 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 2001a).

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 commit 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 variety 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 an available method 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-Wyoming will conduct this analysis.

However, at this point, WS-Wyoming 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, biological/cultural carrying capacity; habitat and environmental factors (such as isolation of target populations, cover types, and access to target individuals), socioeconomic concerns, 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. Also, please see the USDA Wildlife Services (2017c) risk assessment on the use of lead in wildlife damage management.

The use of lead ammunition by APHIS-WS is a small fraction of total lead contamination from many sources. WS-Wyoming 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 Wyoming and elsewhere, in the appropriate calibers. It is also currently more expensive.

WS-Wyoming will follow Department of the 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 its 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 policy also provides exception for special circumstances for wildlife management when non-lead ammunition is unavailable, or not safe under the specific circumstances (U.S. Fish and Wildlife Service Refuge Management 2016).

WS-Wyoming 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-Wyoming 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-Wyoming’s program efforts toward long-term elimination of selected predator populations wherever a cooperative agreement has been initiated with WS-Wyoming. 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-Wyoming 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. WGFD has the authority to manage population levels of regulated species of wildlife through hunting and trapping seasons and depredation permits. WS-Wyoming may assist WGFD as its agent for meeting specific WGFD 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 WGFD 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-Wyoming 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, 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 and Connolly 1980, Burns 1983, Burns and Connolly 1985) and controlled experiments (Sterner 1995). The General Accounting Office (General Accounting Office 2001) reported "…while the coyotes learned not to eat lambs, they still killed them."

In addition, lithium chloride is currently not registered for use by the EPA, and therefore cannot be used or recommended for this purpose. If a product containing lithium chloride is registered in Wyoming 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 manage damage. If WS-Wyoming considers using a product containing lithium chloride, WS-Wyoming 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-Wyoming)

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

In order to accurately identify the species, and even the animal(s) that has/have caused damage or committed depredations, the on-site verification must occur quickly after the event has occurred but 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.

In addition, as several species are regulated in Wyoming as “predatory animals,” anyone may take these species at any time, and private landowners, their employees, or lessees may take trophy game species (black bears, mountain lions, and wolves within the trophy game management area) and other depredating animals in protection of property on private land. This requirement is also outside the scope of this EA, as WS-Wyoming has no authority to implement an independent process for verifying livestock losses.

Requiring entities other than WS-Wyoming to confirm losses could delay responding to requests for assistance. Such delays 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, of the same or different 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 implement requirements for producers on how and where to graze their livestock on private or federal land. However, WS-Wyoming 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-Wyoming 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-Wyoming 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 and grizzly bears, 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 an effective PDM tool because it must be used at close range on the depredating animal, making it extremely dangerous.

Therefore, this alternative is not considered in detail.

2.10.22 Livestock Producers Pay 100% of WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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 WPs, 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-Wyoming, with the exception of M-44s. In the last five years, only 2% of all coyote take by WS-Wyoming 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-Wyoming. Predatory animals under the jurisdiction of the WDA can be taken at any time, by any person per state law. Public hunting and trapping of game and furbearer species collectively, as regulated by WGFD, 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-Wyoming (except for the use of M-44s on federal lands) without any requirement to report take to WDA, unless they are taken under an aerial PDM permit issued by WDA. 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-Wyoming (Sacks et al. 1999a, Sacks et al. 1999b, Larson 2006).

This issue is outside the scope of WS-Wyoming 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-Wyoming currently conducts PDM in WAs only when and where specifically authorized by the land management entity on a case by case basis. PDM activities are conducted in WSAs in accordance with the MOUs and WPs between WS-Wyoming and the land management agencies, and all enacted rules and regulations that are applicable to WS-Wyoming. The current level of PDM activities in this area is not expected to increase significantly in the future under Alternative 1. Some wilderness, proposed wilderness and WSAs in Wyoming have historic grazing allotments. The amount of PDM activities that could be conducted by WS-Wyoming in wilderness, proposed wilderness, or WSAs conforms to legislative guidelines and MOUs between APHIS-WS and the responsible land management agencies.

WS-Wyoming and the land management agency coordinate annually to review and update WPs 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-Wyoming Contracts PDM Activities to the Commercial Sector or Defers All PDM Activities to WGFD

This alternative requires WS-Wyoming to award and oversee contracts for PDM activities to the commercial/private sector; WS-Wyoming would not conduct any technical or direct lethal or non-lethal assistance. All legally authorized methods would also be authorized in such contracts. WS-Wyoming 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-Wyoming would continue to be responsible for environmental and NEPA compliance.

WGFD 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-Wyoming. Any PDM work not conducted by WS-Wyoming, or conducted or authorized by another federal agency, would not require compliance with NEPA.

WS-Wyoming 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-Wyoming 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-Wyoming may recommend habitat modification as part of its technical assistance activities (WS-Wyoming does not conduct this type of activity itself) in all alternatives having WS-Wyoming 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.

2.11 Protective Measures

Protective measures are standardized instructions intended to avoid unwanted results. APHIS-WS and WS-Wyoming 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-Wyoming's cooperating agencies (USFWS and WGFD) are included in the lists below.

2.11.1 General Protective Measures Used by WS-Wyoming 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 conform 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-Wyoming 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-Wyoming 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 coyotes, jackrabbits, porcupines, raccoons, red foxes, skunks, or feral cats damaging resources are made by WS-Wyoming under the authority of WDA. All other species are controlled under WGFD or USFWS authority. Decisions to translocate any species is coordinated with WGFD.
- WS-Wyoming will use Best Management Practices for Trapping by using approved foothold, restraining, and kill traps to capture predators.
- WS-Wyoming will follow any 10(j) or 4(d) rules to manage grizzly bears depredating livestock or pets, after assistance has been requested by WGFD and USFWS. Should grizzly bears be delisted under the ESA then WS-Wyoming shall follow statutes put in place by the State of Wyoming to conserve grizzly bears.

2.11.2.2 Impacts on Populations of Non-target Species

- WS-Wyoming personnel are trained to select the most appropriate method(s) for taking problem animals with little impact on non-target species.
- WS-Wyoming 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-Wyoming, as appropriate, throughout Wyoming 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 are implemented into the WS-Wyoming 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-Wyoming Specialists that the animal is not capable of self-maintenance.
- PDM activities are directed 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-Wyoming 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

North American Wolverine

WS-Wyoming may conduct PDM in areas where the proposed threatened North American wolverine (*Gulo gulo luscus*) may be present. Under the ESA, a "proposed species" warrants listing as threatened or endangered but has not yet been listed. USFWS issued a proposed rule for wolverines in 2016, however no further listing action has been taken. As a proposed species, federal agencies must enter into conference with USFWS under Section 7 of the ESA if the proposed action is "likely to jeopardize the continued existence of a species". While methods used by WS-Wyoming are capable of capturing a wolverine, there is little risk of that occurring under the proposed actions based on the locations where WS-Wyoming generally conducts PDM and the protective measures implemented by WS-Wyoming.

The majority of wolverine habitat falls outside of areas where WS-Wyoming typically conducts PDM. The majority of WS-Wyoming PDM activities occur on private property below 7,000 feet elevation in open livestock grazing areas, mountain valleys, open prairies, high desert, or sagebrush habitats. Monitoring efforts have reported that wolverines in the GYE and Idaho avoided areas less than 7,000 feet in elevation (Copeland et al. 2007, Inman et al. 2012), and that natal dens in the GYE occurred between 7,218-9,259 feet (Inman et al. 2007).

WS-Wyoming has implemented the following protective measures in occupied wolverine habitat above 7,000 feet to prevent unintentional take.

- In areas of Wyoming on National Forest lands where wolverines may occur, foothold traps set by WS-Wyoming for capturing wolves, coyotes, and mountain lions and foot snares set for black bears, grizzly bears, or mountain lions will be placed away from animal carcasses and not use musky or castor-based olfactory lures, unless the use of these lures are absolutely necessary. Additionally, a detailed site assessment will be performed by WS-Wyoming personnel to ensure no fresh wolverine sign is present. If sign or other information (e.g., reports from USFS) indicates wolverines are actively using the project area, foothold traps will not be used.
- Neck snares set for capturing black bears, wolves, coyotes, and mountain lions in occupied wolverine habitat will be placed away from animal carcasses, will not use musky or castor-based lures and WS-Wyoming will perform a detailed site assessment to ensure no fresh wolverine sign is present.

Grizzly Bears

Through consultation with the USFWS, WS-Wyoming determined that the grizzly bear might potentially be affected by WS-Wyoming PDM activities. The USFWS has concurred that WS-Wyoming PDM methods are not likely to jeopardize grizzly bears (U.S. Fish and Wildlife Service 2015b). WS-Wyoming adopted and implemented the following conservation measures:

- WS-Wyoming will assist the USFWS and WGFD with grizzly bear recovery by maintaining interagency coordination and communication, reporting grizzly bear sightings, assisting with grizzly bear damage management, and assisting with research projects related to grizzly bear conservation and recovery;
- WS-Wyoming personnel will be trained in the identification of grizzly bears (particularly in distinguishing between black bears and grizzly bears) and grizzly bear sign, training will be conducted by WS-Wyoming, in collaboration with the local USFWS or WGFD offices and by attending annual bear handling workshops organized by the USFWS and WGFD; and
- WS-Wyoming personnel will carefully consider the possibility of the presence of grizzly bears before conducting any predator damage management activities within or adjacent to occupied grizzly bear habitat and if there are foreseeable conflicts with grizzly bears, WS will adjust their operations accordingly to minimize the chances of adversely affecting grizzly bears.
- WS-Wyoming does not utilize neck snares set for mountain lions, black bears, or gray wolves, with or without stops, within occupied grizzly bear habitat between March 1 and December 1 unless specifically authorized. Neck snares set for coyotes without breakaway locks are not used in areas occupied by grizzly bears between March 1 and December 1.

Canada Lynx

Through consultation with the USFWS, WS-Wyoming made a determination WS-Wyoming PDM activities may affect, and likely to adversely affect the Canada lynx. The USFWS has concluded that WS-Wyoming PDM methods are not likely to jeopardize Canada lynx and issued an Incidental Take Statement (U.S. Fish and Wildlife Service 2007b). WS-Wyoming adopted and implemented the following conservation measures:

- Training: WS personnel will be trained in the identification of Canada lynx and lynx sign. WS will be responsible for training and will coordinate and inform the Service of training.
- Reporting: WS will report all sightings and the locations of Canada lynx to the Service as soon as possible.
- Restricting Actions: WS will restrict wildlife damage management activities in areas of occupied lynx habitat.
- Restricting Attractants: In occupied lynx habitat in Wyoming, WS will only use olfactory attractants in coyote traps. Fish oil and anise oil attractants, fresh meat, and visual attractants that entice felids will not be used. This will minimize the attractiveness of bait sets to lynx.
- Shooting (including aerial operations): WS personnel will positively identify the species of an animal before it is shot.
- Neck Snares and Foot Snares: Neck snares used to capture mountain lions and bears will have a cable loop large enough to preclude capture of lynx (12inches or larger). In occupied lynx habitat, WS will only use foot snares set for large predators (mountain lions, bears and wolves) with pan-tension adjusted to reduce the likelihood of capturing lynx.
- Denning: WS personnel will positively identify species of the target animals before control actions are conducted at den sites.
- M-44s: WS personnel will only bait M-44s with attractants selective to canids. WS personnel will comply with the Environmental Protection Agency label and use restrictions.

- Livestock Protection Collars: WS will use livestock protection collars primarily on sheep and goats. Sheep and goats are not normally targeted prey of lynx.
- Trained Dogs: WS will use tracking dogs that are trained to follow the specific scent of target animals. If dogs inadvertently pursue lynx, they will be called off the trail.
- Foot-hold Traps and Cage Traps: In occupied lynx habitat, WS will not use fish oil and anise oil attractants, fresh meat, and visual attractants that entice felids in traps set for coyotes. In occupied lynx habitat, WS will only use leg-hold traps set for large predators that are equipped with pan-tension devices that reduce the likelihood of capturing lynx.

Northern Long-eared Bat

On February 6, 2015 the USFWS issued a conference concurrence that WS-Wyoming activities may affect but were not likely to adversely affect the then-proposed northern long-eared bat. Since then, the species was listed as federally threatened under the ESA. After the listing, WS-Wyoming requested the USFWS adopt the conference concurrence as official concurrence under section 7(a)(2) of the ESA. The USFWS adopted the conference concurrence as consultation concurrence and advised WS-Wyoming wildlife damage management activities should be considered to be in compliance with the ESA (U.S. Fish and Wildlife Service 2019). This was based on the following:

- The rarity of the species and its limited distribution in Wyoming;
- Bat-related actions by WS are infrequent, typically near houses or other structures, and not expected to occur in forested habitat typical of northern long-eared bats;
- WS will not take bats lethally except in the instance of a sick bat;
- WS will contact the Service to re-initiate consultation if a northern long-eared bat is taken, if applicable; and
- Bats are typically freed after capture unless they show signs of injury or disease or have bitten someone.

Preble's Meadow Jumping Mouse

The USFWS concurred with WS-Wyoming's determination that PDM activities were not likely to adversely affect Preble's meadow jumping mouse (U.S. Fish and Wildlife Service 2015a). This concurrence was based on the following:

- WS-Wyoming will not use or recommend pesticides (including rodenticides) or rodent Conibear or snap traps in Preble's meadow jumping mouse habitat within the range of the species;
- Beaver dams, if breached, will be done by hand within the range of the species and will not involve surface disturbing activities or the use of heavy equipment; and
- If activities are proposed other than what is currently described in the BA, then WS-Wyoming will re-initiate consultation with the Service over that activity.

Yellow-billed Cuckoo

The USFWS concurred with WS-Wyoming's determination that PDM activities are not likely to adversely affect the western distinct population segment of the yellow-billed cuckoo (U.S. Fish and Wildlife Service 2015a). This concurrence was based on the following:

- WS-Wyoming project description
- The rarity of the species in Wyoming, and

- WS-Wyoming commitments to minimize activities such as shooting, hazing and use of explosive devices in known occupied cuckoo breeding/nesting habitat (through consultation with USFWS) from late-April through late September.
- If cuckoos are observed by WS-Wyoming during the normal course of duties in areas outside breeding habitat, during the breeding season, the use of propane cannons or pyrotechnics will be discontinued unless the risk to cuckoos or human health and safety is greater (i.e., at airports). If WS-Wyoming cannot discontinue the use of cannons or pyrotechnics for human health or safety reasons, WS-Wyoming will reinitiate consultation.

Black-footed Ferret

The USFWS concurred with WS-Wyoming's determination that PDM activities are not likely to jeopardize the continued existence of the Shirley Basin population as, by definition any effects to a non-essential, experimental population will not likely jeopardize the continued existence of the species (U.S. Fish and Wildlife Service 2015a). The USFWS also concurred with WS-Wyoming's determination that PDM activities outside the Shirley Basin are not likely to adversely affect black-footed ferrets, as the USFWS block-cleared the remainder of Wyoming for the presence of wild, federally endangered black-footed ferrets. The Meeteetse experimental non-essential population falls under 10(j) guidelines and is block-cleared by the USFWS therefore is not subject to consultation requirements.

WS-Wyoming has implemented the following conservation measures to minimize the potential for capture of a black-footed ferret during PDM activities:

- WS-Wyoming uses traps with pan-tension devices that preclude capture of black-footed ferrets
- WS-Wyoming does not undertake prairie dog control measures in prairie dog towns.
- WS-Wyoming will not use M-44 devices near prairie dog towns to protect the black-footed ferret.

Interior Least Tern

WS-Wyoming determined PDM activities would have no effect on the interior least tern (U.S. Fish and Wildlife Service 2015a). WS-Wyoming adopted and implemented the following SOPs at that time:

- WS-Wyoming will avoid the use of frightening devices where least terns are seen. If a least tern becomes a persistent threat at an airport, WS-Wyoming may request an emergency Section 10 permit from USFWS to haze the bird from the airfield.
- WS-Wyoming may conduct PDM for the protection of least terns but will use caution on nesting areas such as sand bars and islands to avoid the possibility of crushing an egg or nestling. WS-Wyoming or the entity requesting protection for these species from WS-Wyoming will coordinate such activities with USFWS.
- WS-Wyoming will not use mist nets or noose mats specifically placed for shorebirds for projects such as disease surveillance in areas where least terns have been seen. Before conducting such projects, WS-Wyoming will ensure that these species are not in the area.

Piping Plover

WS-Wyoming determined PDM activities would have no effect on the piping plover (U.S. Fish and Wildlife Service 2015a). WS-Wyoming adopted and implemented the following SOPs at that time:

- WS-Wyoming will avoid the use of frightening devices where piping plovers are seen. If a piping plover becomes a persistent threat at an airport, WS-Wyoming may request an emergency Section 10 permit from USFWS to haze the bird from the airfield.

- WS-Wyoming may conduct PDM for the protection of piping plovers but will use caution on nesting areas such as sand bars and islands to avoid the possibility of crushing an egg or nestling. WS-Wyoming or the entity requesting protection for these species from WS-Wyoming will coordinate such activities with USFWS.
- WS-Wyoming will not use mist nets or noose mats specifically placed for shorebirds for projects such as disease surveillance in areas where piping plovers have been seen. Before conducting such projects, WS-Wyoming will ensure that these species are not in the area.

Whooping Crane

WS-Wyoming determined PDM activities would have no effect on the whooping crane (U.S. Fish and Wildlife Service 2015a). WS-Wyoming adopted and implemented the following SOP at that time:

- WS-Wyoming will not use rodenticides, avicides, foothold traps, or snares in areas where whooping cranes have been seen such as agricultural fields, open grassy areas, and wetlands while they migrate through the state.

T&E Fish Species

WS-Wyoming determined PDM activities would have no effect on Kendall Warm Springs daces, pallid sturgeons, bonytail chubs, razorback suckers, humpback chubs, or Colorado pikeminnows (U.S. Fish and Wildlife Service 2015a). WS-Wyoming adopted and implemented the following SOP at that time:

- If WS-Wyoming personnel start a project to remove invasive aquatic species from an area for the protection of T&E fish species, WS-Wyoming or the entity requesting protection for these species from WS-Wyoming will consult USFWS at the site-specific level.

Wyoming Toad

WS-Wyoming determined PDM activities would have no effect on the Wyoming toad (U.S. Fish and Wildlife Service 2015a). This determination was based on the extremely limited range of the Wyoming toad, and WS-Wyoming not conducting PDM in these areas.

T&E Plant Species

WS-Wyoming determined PDM activities would have no effect on blowout penstemon, Ute ladies'-tresses, desert yellowheads, or western prairie fringed orchids (U.S. Fish and Wildlife Service 2015a). WS-Wyoming adopted and implemented the following SOP at that time:

- WS-Wyoming personnel will not collect plants while afield.
- WS personnel who use ATVs will follow established roads and trails as much as possible. Minimal travel is expected off-trail, but WS personnel will avoid travelling the same areas repeatedly so that new trails are not created.

On December 2, 2020, USFWS proposed to list whitebark pine (*Pinus albicaulis*) as a threatened species under the federal ESA. Under the ESA, a "proposed species" warrants listing as threatened or endangered but has not yet been listed. Because this species has been proposed for listing, federal agencies must enter into conference with USFWS under Section 7 of the ESA if the proposed action is "likely to jeopardize the continued existence of a species". There is little risk of WS-Wyoming damaging whitebark pine under the proposed actions based on the locations where WS-Wyoming generally conducts PDM and the protective measures implemented by WS-Wyoming. USFWS' proposal to list whitebark pine as a threatened species will not significantly impact the continuation of WS-Wyoming actions or alter the conclusions of environmental impact in the EA.

2.11.2.4 Measures to Ensure Minimal Impacts from Aerial PDM Overflights

WS-Wyoming 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-Wyoming only responds to wildlife damage; once the damage has been mitigated, WS-Wyoming discontinues activities. WS-Wyoming PDM activities are short in duration, with minimal impact on plant and animal communities, negating any potential impact on ecosystem function.

WS-Wyoming conducts environmental analyses as required under NEPA to ensure 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 WPs, or on WP 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 (Bureau of Land Management 1988). 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-Wyoming 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 WP and deemed appropriate.
- All pesticides used by WS-Wyoming are registered with EPA and WDA. WS-Wyoming employees will comply with each pesticide's directions and labeling, in addition to EPA and WDA rules and regulations.
- WS-Wyoming 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 WDA-approved programs. WS-Wyoming employees who use these chemicals participate in continuing education programs to keep abreast of developments and to maintain their certifications.
- M-44s are only used by those WS-Wyoming personnel who are trained and have received state certification from WDA to use sodium cyanide. PDM activities that involve the use of these chemicals are conducted in accordance with WDA 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 will be set no closer than ¼ mile to a residence, except a residence owned by the cooperator.

Additional details on APHIS-WS M-44 device placement requirements, how local areas are informed of M-44 use, and other M-44 safety protocols can be found in WS-Directive 2.415 (M-44 Use and

Restrictions Updated 5/14/2020), the Use of Sodium Cyanide in Wildlife Damage Management Risk Assessment (USDA Wildlife Services 2017c), and the M-44 Device for Predator Control WS Factsheet on the USDA-APHIS website (https://www.aphis.usda.gov/publications/wildlife_damage/fs-m44-device.pdf).

2.11.2.7 Impacts on Use of Public Lands

- WS-Wyoming will conduct PDM in WAs only when and where specifically authorized by the land management entity on a case-by-case basis. PDM activities conducted in all other SMAs including WSAs and RMAs would be in accordance with the MOUs and WPs between WS-Wyoming and the land management agencies, and all enacted rules and regulation that are applicable to WS-Wyoming.
- WS-Wyoming personnel follow all laws and regulations applicable to WS-Wyoming 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-Wyoming conducts PDM in accordance with all laws applicable to WS-Wyoming 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 management agency and conforms to RMPs and LRMPs.
- PDM in WAs will be in accordance with Wilderness Policies and MOUs applicable to WS-Wyoming PDM activities.
- WS-Wyoming does not anticipate conducting PDM in National Parks. The potential exists that a request could come from the National Park Service (NPS) or WGFD for responding to a threat to human health and safety or for research purposes. If WS-Wyoming 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-Wyoming PDM.

2.11.2.8 Impacts on Other Sociocultural Issues

- WS-Wyoming will consult with Native American tribes prior to conducting PDM on tribal lands.

  Humaneness and Ethical Perspectives.

  - Chemical immobilization and euthanasia procedures that do not cause pain or undue stress are used by certified personnel when practical and where safe.
  - WS-Wyoming 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 (American

Veterinary Medical Association 1987;2001;2013a). In some situations, accepted chemical immobilization and euthanasia methods are used.

- Traps are set and inspected according to WGFD 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 Wyoming 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-Wyoming PDM Program

The methods used by WS-Wyoming to take target predators under the current program were discussed in Chapter 2. 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 shooting net guns, hunting dogs, M-44s (sodium cyanide ejectors), and denning (gas cartridges). Other methods may be used, but most of these would be employed by the resource owner.

During FY14-18, WS-Wyoming conducted PDM on agreements which comprised a total of 53,125 mi^2, which is 54% of the 97,798 mi^2 in the State of Wyoming. Additionally, PDM is typically only conducted by WS-Wyoming on a small proportion of any property under agreement. For example, WS in New Mexico (USDA Wildlife Services 1997b) 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 this approximates the situation in Wyoming, where WS actually conducts PDM on approximately 1/5 of lands under agreement. Using this calculation, less than 11% of the land area of Wyoming was exposed to WS-Wyoming PDM in a given year during FY14-18. 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-Wyoming 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-Wyoming conducts PDM for 20 mammalian predator and predatory animal species in Wyoming (See Table 1-1) but has only conducted lethal operations for 15 of these (Table 3-1). If WS-Wyoming were asked to target any other predators in Wyoming to alleviate damage, WS-Wyoming would supplement this analysis before any actions could be taken. The primary target species taken yearly in Wyoming are coyote, raccoon, striped skunk, red fox, and to a lesser extent, badger, feral cat, white-tailed jackrabbit, black-tailed jackrabbit, porcupine, bobcat, Virginia Opossum, black bear, feral dog, mountain lion, and mink. These latter eight species are taken by WS-Wyoming only occasionally. WS-Wyoming can also target grizzly bears, western spotted skunks, eastern spotted skunks, long-tailed weasels, and short-tailed weasels, but has not done so lethally in the period between FY14 through FY18. On average, coyotes represented 80% of this take. In addition, this take includes raccoons (12%), striped skunks (3%), red foxes (3%), badgers (0.4%), feral cats (0.4%), and others (less than 1.2%).

Table 3-1. WS-Wyoming lethal take of predator species for predator damage management during federal fiscal years 2014-2018.

Species	**FY14**	**FY15**	**FY16**	**FY17**	**FY18**	**Average**
Coyote	5,327	6,521	7,942	5,645	6,231	6,333
Raccoon	1,818	1,096	712	546	547	944
Striped Skunk	321	262	296	195	254	266
Red Fox	188	181	416	237	148	234
Badger	30	11	58	39	36	35
Feral Cat	74	25	26	29	12	33
White-tailed Jackrabbit	8	0	20	86	0	23

Species	FY14	FY15	FY16	FY17	FY18	Average
Black-tailed Jackrabbit	0	89	0	0	0	18
Porcupine	21	8	10	3	6	10
Bobcat	11	5	7	4	10	7
Virginia Opossum	2	0	0	10	7	4
Black Bear	2	2	1	0	4	2
Feral Dog	0	0	0	0	3	<1
Mountain Lion	1	0	0	1	0	<1
Mink	0	0	0	1	0	<1
Total	7,803	8,200	9,488	6,796	7,258	7,909

Data include all target and non-target take by WS-Wyoming

Table 3-2 presents the average WS-Wyoming take, and cumulative take, of predator species. 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. WGFD, in consultation, supports that actions by WS-Wyoming will not negatively impact species classified as furbearers or trophy game under the management authority of WGFD. 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 as defined in this EA targeted by WS-Wyoming for predator damage management during federal fiscal years 2014-2018.

Species	WS Take[a]	WS Removal Burrows/Dens[b]	Sportsman Harvest[c]	Cumulative Take[d]	Estimated Population	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate[e]	Significant Impact?
Coyote	6,333	162	ND	7,649	86,601	7.31%	8.83%	60%	No
Raccoon	944	N/A	ND	ND	127,000	0.58%	ND	49%	No
Striped Skunk	266	<1	ND	ND	195,596	0.13%	ND	10%	No
Red Fox	234	36	ND	13	97,798	0.24%	0.25%	64%	No
Badger	35	N/A	878	913	ND	ND	ND	10%	No
Feral Cat	33	N/A	N/A	ND	ND	ND	ND	N/A	No
White-tailed Jackrabbit	23	N/A	ND	ND	694,098	0.003%	ND	10%	No
Black-tailed Jackrabbit	18	N/A	ND	ND	273,265	0.006%	ND	10%	No
Porcupine	10	N/A	ND	ND	240,583	0.004%	ND	10%	No
Bobcat	7	N/A	1,468	1,476	ND	ND	ND	19%	No
Virginia Opossum	4	N/A	ND	ND	ND	ND	ND	10%	No
Black Bear	2	N/A	445	455	ND	ND	ND	14%	No
Feral Dog	<1	N/A	N/A	ND	ND	ND	ND	N/A	No
Mountain Lion	<1	N/A	276	280	ND	ND	ND	11%	No
Mink	<1	N/A	157	157	ND	ND	ND	30%	No
Feral Dog	<1	N/A	N/A	ND	ND	-	ND	N/A	No
Grizzly Bear	-	N/A	N/A	19	709*	-	2.67%	N/A	No
W. Spotted Skunk	-	N/A	ND	ND	55,419	-	ND	10%	No
E. Spotted Skunk	-	N/A	ND	ND	27,709	-	ND	10%	No
Long-tailed Weasel	-	N/A	56*	56	ND	-	ND	10%	No
Short-tailed Weasel	-	N/A	56*	56	ND	-	ND	50%	No

[a]WS Take is average annual lethal take, including nontarget take, during FY14-18;[b]WS Take Burrows/Dens is average annual take [c]Sportsman Harvest data from WGFD; [d]For some species, cumulative take includes more than sportsman harvest and WS Take. See species analyses.; [e]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 available); 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, extirpation 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 common to abundant in Wyoming (Buskirk 2016) and found statewide with the highest densities documented in grasslands and sagebrush habitats and the lowest densities in shrubland habitats (Gese and Terletzky 2009). 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. Gese and Terletzky (2009) conducted scat-deposition transects across Wyoming and estimated the statewide coyote population to be 49,854 at a time of year when pups were still in the den and a majority of the annual PDM had been completed. The researchers also calculated a statewide population figure which reflected population size prior to natural and anthropogenic mortality (a high-end estimate). This resulted in a state-wide population estimate of 86,601 coyotes. The researchers proposed this estimate could potentially be used as an estimate of the state population prior to or without any exploitation. 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, 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 (Bekoff and Wells 1982, Allen et al. 1987). 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).

In Wyoming, coyotes are managed by WDA as predatory animals and can be taken year-round, by any individual, with no license or permit required. Whereas they are technically considered carnivores (Order Carnivora), coyotes have an omnivorous diet, and will readily eat crops. Coyote predation on wildlife species in Wyoming, such as mule deer and sage-grouse, has also created elevated concerns in some areas.

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. 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 FY14-18, coyotes were responsible for 69% of the livestock losses recorded by WS-Wyoming, and 71% of the value of all losses due to predators. The value of losses from coyotes averaged $132,292 per year (Table 1-3). They are therefore a major focus of WS-Wyoming PDM efforts, and they make up the largest percentage of the WS-Wyoming predator take (80%). The resources that WS-Wyoming 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 mule deer or sage-grouse). The coyote population in Wyoming was estimated to be 86,601 by Gese and Terletzky (2009), prior to exploitation. This estimate will be used to determine impacts (Table 3-3).

Table 3-3. Overview of coyote impact analysis.

Fiscal Year	WS Take	WS Removal Burrow/ Den	Sportsman Harvest[a]	Other Take[b]	Cumulative Take	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	5,327	178	ND	825	6,152	86,601	6.15%	7.10%	60%	No
FY 2015	6,521	208	ND	1,398	7,919	86,601	7.53%	9.14%	60%	No
FY 2016	7,942	171	ND	1,968	9,910	86,601	9.17%	11.44%	60%	No
FY 2017	5,645	133	ND	1,109	6,754	86,601	6.52%	7.80%	60%	No
FY 2018	6,231	118	ND	1,278	7,509	86,601	7.20%	8.67%	60%	No
Average	**6,333**	**162**	**ND**	**1,316**	**7,649**	**86,601**	**7.31%**	**8.83%**	**60%**	**No**

[a]ND=Not Determined (data not available)
[b]Other take includes aerial shooting by private individuals
[c]Data from (Gese and Terletzky 2009)

WS-Wyoming primarily takes coyotes where they cause conflict with human endeavors; thus, WS-Wyoming take is limited to more human-influenced environments which have been shown to have higher coyote densities, as discussed by Fedriani et al. (2001). Moreover, coyote populations in agricultural areas, where most coyotes are taken by WS-Wyoming, 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-Wyoming took an average of 6,333 coyotes annually during FY14-18, with a range of 5,327 to 7,942. These numbers represent 6.15% to 9.17% of the estimated coyote population in Wyoming. WS-Wyoming also removed an annual average of 162 coyote burrows/dens, with a range of 118 to 208 during FY14-18.

Coyote take by WS-Wyoming 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-Wyoming to be less than 15,000 animals and removal of 400 burrows/dens, accounting for annual variability. This take represents 17.3% of the estimated population, which studies estimate can withstand annual take of at least 60%. While, 15,000 is roughly two-thirds higher than average annual WS take in FY14-18, this number is derived from historical WS-Wyoming take and could be representative of a scenario in which WS-Wyoming provides services to additional PMBs than service is currently provided. Based on this information, PDM by WS-Wyoming would have minor short-term impacts on coyotes locally, and no impact on the overall coyote population in Wyoming.

WS-Wyoming 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 (U.S. Fish and Wildlife Service 1979a), 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.

Windberg et al. (1997) found no statistically significant difference between territorial and transient coyotes in the proportion of each type that consumed Angora goats in New Mexico, and 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-Wyoming 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-Wyoming PDM would be limited to those areas where WS-Wyoming conducts PDM. Such localized impacts would be temporary and would likely have no impact on statewide populations due to the limited area in which WS-Wyoming conducts PDM. These are also natural responses to other environmental factors. WS-Wyoming 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, and removal by private individuals for PDM occurs in Wyoming. WDA does not collect data on sportsman harvest or private individuals take for PDM, with the exception of aerial shooting. Take by private individuals employing aerial shooting as reported to WDA are included in the “Other Take” category (Table 3-3). We have included all of the known take which we are aware of that can be estimated or quantified.

The “Other Take” in Table 3-3 includes aerial PDM by private individuals as reported to WDA (Wyoming Department of Agriculture 2015;2016;2017;2018;2019). WDA’s annual reporting period crosses annual years and begins April 1 of each year. 2014-2015 data was used for FY2014, and so forth, because this is the best match to federal FYs. “Other Take” ranged from 825 to 1,968, with an average of 1,316 coyotes and represents an average harvest of 1.52% of the state’s coyote population, with a high of 2.27% in FY16. These numbers are all well below the 60% sustainable harvest threshold.

Even with under-reporting of "Other Harvest" (*e.g.*, PDM by other individuals, sportsman harvest), the coyote population would not be negatively affected unless this additional harvest totaled more than 44,000 coyotes each year, bringing the cumulative total above 51,961 (60% of the estimated population). This level of PDM or sport hunting take by other individuals is 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-Wyoming might contribute to such an impact. However, the locations where sportsmen harvest coyotes are generally spatially separated from those areas where WS-Wyoming conducts PDM, because coyote abundance is generally lower where WS-Wyoming conducts PDM. Most WS-Wyoming PDM (38% by area, 60% 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 Wyoming. Thus, we anticipate low cumulative impact on local coyote populations in the short-term, and no impact on the overall Wyoming 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 et al. (1978) noted that coyotes have persisted on the landscape despite decades of effort by man to eradicate them.

Cumulative take of coyotes is also largely limited to human-influenced environments, which have been shown to have higher coyote densities, as discussed by Fedriani et al. (2001). Thus, the magnitude of cumulative take in Wyoming 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 General Accounting Office (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) (Kays 2018).

3.1.1.2 Impact on Raccoon Populations

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 highly 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 1987). In Wyoming, they are most common in suburban and urban areas, along waterways and in forests in the less arid portions of Wyoming; they sometimes can be found a long distance from water in a variety of habitats, including desert scrub. Since the 1940s, raccoon populations throughout the U.S. have increased, likely as a result of adaptation to man-made habitats. Raccoons are found throughout most of Wyoming, with the exception of high elevation mountain ranges (Buskirk 2016).

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 foxes, 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/mi^2 to 80/mi^2 (Yeager and Rennels 1943, Urban 1970, Sonenshine and Winslow 1972, Hoffman and Gottschang 1977, Fritzell 1978, Rivest and Bergerson 1981, Armstrong et al. 2011). Wyoming probably has some good raccoon habitat areas with high densities of raccoons (urban/suburban and riparian areas). However, statewide, raccoon densities are low because ideal habitat is sparse.

We believe that 127,000 raccoons is a conservative population estimate for Wyoming, using the lowest density figure (1.3/mi^2) (Table 3-4).

Raccoons are managed as a predatory animal in Wyoming, and WDA is responsible for oversight of raccoon management.

WS-Wyoming recorded an average of $6,445 in losses annually during FY14-18. Raccoons caused damage to livestock, property, crops, and threatened human health & safety.

Sanderson (1987) 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.

Table 3-4. Wyoming raccoon impact analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take[b]	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.[b]	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	1,818	ND	ND	127,000	1.43%	ND	49%	No
FY 2015	1,096	ND	ND	127,000	0.06%	ND	49%	No
FY 2016	712	ND	ND	127,000	0.56%	ND	49%	No
FY 2017	546	ND	ND	127,000	0.43%	ND	49%	No
FY 2018	547	ND	ND	127,000	0.43%	ND	49%	No
Average	**944**	**ND**	**ND**	**127,000**	**0.58%**	**ND**	**49%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]ND=Not Determined (data not available)
[c]Estimate derived by multiplying reported density by area of distribution

Direct Impacts: WS-Wyoming took an average of 944 raccoons per year during FY14-18, with a range of 543 to 1,818 (Table 3-4). This corresponds to an average of 0.58% of the estimated statewide raccoon population, with a maximum of 1.43% of the estimated raccoon population in Wyoming. Under Alternative 1, we anticipate that WS-Wyoming would take no more than 3,000 raccoons in a given year. This corresponds to less than 2.4% 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-Wyoming takes very few raccoons outside of human influenced environments. Within urban environments, local 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-Wyoming PDM would have a negligible impact on natural raccoon populations locally. We anticipate no impact to statewide raccoon populations in Wyoming under Alternative 1.

Indirect Impacts: Raccoon take by WS-Wyoming is largely limited to human influenced 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-Wyoming 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-Wyoming which might negatively affect raccoons.

Cumulative Impacts: Sportsman harvest and PDM by other individuals is not estimated by WDA. Even with no reporting of these types of take, the raccoon population would not be negatively affected unless this additional harvest totaled more than 61,000 raccoons each year, bringing the cumulative total above 62,230 (49% of the estimated population). This level of PDM or sport hunting take by other individuals is extremely unlikely, due to the level of effort which would be required. Moreover, occasional years with take above the 49% threshold would also not impact the raccoon population, as long as such take levels are not sustained long-term. Raccoon populations are considered to be increasing throughout their range, and they are listed as a species of “least concern” according to the IUCN (Timm et al. 2016).

3.1.1.3 Impact on Striped Skunk Populations

Striped skunks (*Mephitis mephitis*) are the most common skunk species in Wyoming. Striped skunks are found throughout the United States, including all of Wyoming, and have expanded their range with the expansion of humans. 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 other skunk species are mostly associated with grasslands and rocky areas, such as canyons and outcrops (Rosatte 1987). Skunks eat a variety of food, including small rodents, insects, fruits, and eggs, and sometimes 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 1987). 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 Jr. 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 conditions, 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 Wyoming. Using this figure, we estimate the striped skunk population in Wyoming at approximately 195,596. 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 zoonotic diseases such as rabies to humans, domestic animals, and livestock; and sometimes prey on poultry and their eggs and are primarily targeted to address these types of problems. The majority of damage complaints are due to skunks living and spraying in and around residences, with most attributed to striped skunks. WS-Wyoming recorded average annual losses of $53 due to striped skunks during FY14-18. This was mostly due to property damage caused by digging and foraging behavior. Most of the skunk damage reported to WS-Wyoming was due to nuisance skunks, and threats to human health & safety. Many of these reflect the threat of skunk rabies, which has been spreading through Wyoming in recent years. These reports do not include any dollar amount of loss, so they are not included in the reported annual losses above.

Striped skunks are managed as a predatory animal in Wyoming, and WDA is responsible for oversight of striped skunk management.

Direct Impacts: WS-Wyoming took an average of 266 striped skunks annually in Wyoming between FY14-18, which is less than 0.13% of the estimated statewide striped skunk population. WS-Wyoming take ranged from 195 to 321 (Table 3-5). WS-Wyoming also removed one skunk den during this same time period. Under Alternative 1, we anticipate that WS-Wyoming would take less than 400 striped skunks in any year, which represents less than 0.21% of the statewide population, and less than 5 striped skunk dens or burrows. As such, we anticipate no impact on the statewide striped skunk population. Local natural populations of striped skunks would not be affected because WS-Wyoming takes very few skunks outside of human influenced environments. Within urban and suburban 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 3-5. Overview of striped skunk impact analysis.

Fiscal Year	WS Take[a]	WS Removal Dens/ Burrows	Sportsman Harvest[b]	Cumulative Take[b]	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.[b]	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	321	1	ND	ND	195,596	0.16%	ND	10%	No
FY 2015	262	0	ND	ND	195,596	0.13%	ND	10%	No
FY 2016	296	0	ND	ND	195,596	0.15%	ND	10%	No
FY 2017	195	0	ND	ND	195,596	0.10%	ND	10%	No
FY 2018	254	0	ND	ND	195,596	0.13%	ND	10%	No
Average	**266**	**0.2**	**ND**	**ND**	**195,596**	**0.13%**	**ND**	**10%**	**No**

[a]WS Take is all lethal take, including nontarget take
[b]ND=Not Determined (no data available)
[c]Estimate derived by multiplying reported density by area of distribution

__Indirect Impacts__: Striped skunk take by WS-Wyoming is largely limited to urban and suburban areas, so the potential indirect impacts are limited to those areas. In urban and suburban 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. However, 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-Wyoming PDM might alter the rate of immigration, which might affect the age structure. Because these urban and suburban 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 and suburban populations are already affected by high mortality due to vehicle collisions, 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-Wyoming.

__Cumulative Impacts__: Sportsman harvest and PDM by other individuals is not estimated by WDA. Even with no reporting of these types of take, the skunk population would not be negatively affected unless this additional harvest totaled more than 19,294 skunks each year, bringing the cumulative total above 19,560 (10% of the estimated population). This level of PDM or recreational take by other individuals is extremely unlikely, due to the level of effort which would be required and given that recreational trappers rarely target striped skunks. Moreover, occasional years with take above the 10% threshold would also not impact the skunk population, as long as such take levels did not continue long-term. Using the conservative long-term sustainable harvest threshold of 10%, it is likely that the level of cumulative take occurring in Wyoming 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 (Helgen and Reid 2016a).

3.1.1.4 Impact on Red Fox Populations

Red foxes (*Vulpes vulpes*) are found throughout much of North America and are common but vary in abundance across Wyoming. In the early 1900s, red foxes were not as abundant in WY. Starting in the 1960s, red foxes became more common and today are most commonly found near cities and towns

(Buskirk 2016). 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 levels of mortality within populations (Phillips and Mech 1970, Andrews et al. 1973, Storm et al. 1976, Pils and Martin 1978, Harris 1979, Voigt and MacDonald 1984, Voigt 1987, Allen and Sargeant 1993). Red foxes have a varied diet, which includes small mammals, birds, insects and mast, but they will also kill and eat livestock (lambs, kid goats) and poultry. Of the three fox species occurring in Wyoming, red foxes cause the most damage, often targeting livestock. Voigt and Earle (1983) and Gese et al. (1996) found that red foxes avoided coyotes, but coexisted in the same areas and habitats.

Red foxes have a home range of 1-2 mi^2, but often travel more extensively. 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 foxes 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 1987). Ables (1969) and Sheldon (1950) reported that more than one female was observed at the den and suggested that red foxes use "helpers" for pup rearing, 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 (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986, Voigt 1987). Much of the available habitat in Wyoming, including agricultural and suburban habitats, would support densities of red foxes on the higher end of this scale; very little of the State is low-density habitat such as alpine tundra (Voigt 1987). An average density for red foxes in Wyoming might be conservatively estimated at 1/mi^2. Considering that red foxes occupy all of Wyoming, and that Wyoming encompasses 97,798 mi^2, we estimate the population of red foxes in Wyoming to be approximately 97,798, with highest densities occurring in suburban and agricultural areas.

WDA is responsible for the management of red foxes in Wyoming, which are classified as predatory animals. 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 Jr et al. 1976, Pils and Martin 1978, Sargeant 1978, Voigt 1987, Allen and Sargeant 1993). WS-Wyoming recorded an annual average of $4,881 in damages due to red foxes in FY14-18 (Table 1-3). These damages were mostly attributed to depredations of livestock, including lambs, kids and poultry (Table 1-4).

Long-term sustainable harvest rates for red foxes have been reported at 64-76% (Layne and McKeon 1956) and up to 70% (Davis 1974). We will use the more conservative rate of 64% as the sustainable harvest threshold, below which red fox populations would not be expected to be impacted.

Direct Impacts: WS-Wyoming took an annual average of 234 red foxes in Wyoming from FY14-18, which is 0.24% of the estimated statewide population FY14-18 (Table 3-6). Red fox take by WS-Wyoming ranged from 148 to 416. This level of take represents a maximum of 0.43% of the red fox population in Wyoming. WS-Wyoming also removed an annual average of 36 red fox burrows or dens in FY14-18. Under Alternative 1, we anticipate that WS-Wyoming will take less than 600 red foxes in a given year and remove less than 100 burrows or dens. This represents 0.61% of the estimated red fox population, which is well below the 64% sustainable harvest rate.

Under Alternative 1, we anticipate a negligible impact on red foxes locally, and no impact on statewide red fox populations in Wyoming. Red fox take by WS-Wyoming may result in a temporary decrease in localized 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 80% of WS-Wyoming's average annual predator take, while red foxes comprise only 3%. 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 transitory at best. 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-Wyoming. We anticipate indirect impact to statewide red fox populations to be negligible.

Table 3-6. Overview of red fox impact analysis.

Fiscal Year	WS Take[a]	WS Removal Burrows/ Dens	Sportsman Harvest[b]	Other Take[c]	Cumulative Take	Estimated Population[d]	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	188	28	ND	14	202	97,798	0.19%	0.21%	64%	No
FY 2015	181	39	ND	33	214	97,798	0.19%	0.22%	64%	No
FY 2016	416	55	ND	8	424	97,798	0.43%	0.43%	64%	No
FY 2017	237	27	ND	7	244	97,798	0.24%	0.25%	64%	No
FY 2018	148	31	ND	4	152	97,798	0.15%	0.16%	64%	No
Average	**234**	**36**	**ND**	**13**	**247**	**97,798**	**0.24%**	**0.25%**	**64%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]ND=Not Determined (no data available)
[c]Other take includes aerial shooting by private individuals.
[d]Estimate derived by multiplying reported density by area of distribution

Cumulative Impacts: Sportsman harvest, and removal by private individuals for PDM occurs in Wyoming. WDA does not collect data on sportsman harvest or take by private individuals for PDM, with the exception of aerial shooting. Take by private individuals employing aerial shooting as reported to WDA is included in the "Other Take" category (Table 3-6). We have included all of the known take which we are aware of that can be estimated or quantified.

The "Other Take" category in Table 3-6 includes aerial PDM by private individuals as reported to WDA (Wyoming Department of Agriculture 2015;2016;2017;2018;2019). WDA's annual reporting period crosses annual years and begins April 1 of each year. Data for 2014-2015 was used for FY2014, and so forth, because this is the best match to federal FYs. "Other Take" ranged from 4 to 33, with an average of 13 red foxes per year. This represents an average harvest of 0.01% of the state's red fox population, with a high of 0.03% in FY15. These numbers are all well below the 64% sustainable harvest threshold.

Even with under-reporting of "Other Harvest" (*e.g.*, PDM by other individuals, sportsman harvest), the red fox population would not be negatively affected unless this additional harvest totaled more than 62,357 red foxes each year, bringing the cumulative total above 62,591 (64% of the estimated population). This level of PDM or sport hunting take by other individuals is extremely unlikely, due to the level of effort which would be required. Moreover, occasional years with take above the 64% threshold would not impact the red fox population, as long as such take levels did not continue long-term.

Under Alternative 1, we anticipate similar levels of cumulative take, with a maximum cumulative take of 1,000 red fox. This level of cumulative take is equal to 1% of the state-wide estimated red fox population, which is well below the reported long-term sustainable harvest rate of 64%.

This represents a maximum harvest of 1% of the estimated red fox population, which can withstand long-term harvest of 64%. 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, an indeterminate number of red foxes are taken annually without our knowledge, including those taken by private citizens for PDM and sportsman harvest (which are not reported). 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 (Hoffmann and Sillero-Zubiri 2016).

3.1.1.5 Impact on Badger Populations

American badgers (*Taxidea taxus*) are found throughout most of the western states and occur throughout Wyoming at moderate densities. Badgers occupy most open habitats in Wyoming. They prefer open habitats and avoid densely wooded areas, although they will enter forest margins. In Wyoming, badgers occur in grassland and shrub-steppe habitats (Buskirk 2016). 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 1987). Goodrich and Buskirk (1998) reported a density of 2-2.8/mi^2 in Carbon County, Wyoming.

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 Wyoming, but we are not aware of any other published sustainable harvest rates for badgers. 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 FY14-18, WS-Wyoming recorded an annual average of $7,329 in losses due to badgers. WGFD estimates that sportsmen harvested an annual average of 878 badgers in Wyoming in recent years (Table 3-7; Pers. Comm. G. Frost September 27, 2019, e-mail). Badgers are classified as furbearing animals in Wyoming and managed by WGFD. WS-Wyoming annually receives a Chapter 56 permit from the WGFD for the lethal take of furbearing animals. As a condition of this permit, WS-Wyoming annually reports activities that have occurred under this permit, including lethal take. This reporting process allows for quantification of population assessments and trajectory. Any furbearer taken by WS-Wyoming is quantified as part of WGFD analyses of wildlife populations. WS-Wyoming occasionally takes badgers, most often for the protection of livestock.

Direct Impacts: WS-Wyoming took an average of 35 badgers annually during FY14-18, with a maximum of 58 badgers in FY16 (Table 3-7). Under Alternative 1, we anticipate that WS-Wyoming would take up to 200 badgers in any year. These levels of take would have negligible impacts on local badger populations, and no impact on the statewide badger population.

Indirect Impacts: 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, we do not expect any significant indirect impacts to badgers due to PDM conducted by WS-Wyoming.

Cumulative Impacts: Cumulative harvest averaged 913 annually between FY14-18, with a maximum of 1,436 in FY17. Under Alternative 1, we anticipate cumulative take of no more than 2,000 badgers in any year. Under Alternative 1, we anticipate negligible impacts to local badger populations, and no impact to the overall badger population in Wyoming.

Throughout its range, the American badger is considered to be decreasing, but is still considered a species of "least concern" by the IUCN (Helgen and Reid 2016c).

Table 3-7. Overview of badger impact analysis.

Fiscal Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	30	721	751	ND	ND	ND	10%	No
FY 2015	11	611	622	ND	ND	ND	10%	No
FY 2016	58	704	762	ND	ND	ND	10%	No
FY 2017	39	1,397	1,436	ND	ND	ND	10%	No
FY 2018	36	955	994	ND	ND	ND	10%	No
Average	**35**	**878**	**913**	**ND**	**ND**	**ND**	**10%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]Data from WGFD (2019).
[c]ND=Not Determined (no data available)

3.1.1.6 Impact on Feral Cat Populations

Feral cats are fairly common throughout Wyoming, and primary responsibility for responding to feral cat incidents rests with county and local authorities, such as local law enforcement. Feral cats are classified as predatory animals and management authority rests with WDA. WS-Wyoming primarily takes feral cats for the protection of human health & safety (disease threat) or property damage. WS-Wyoming receives few such requests.

Direct, Indirect, and Cumulative Impacts: WS-Wyoming killed an average of 33 feral cats annually during FY14-18, with a maximum of 74 in FY14 (Table 3-1). An additional 65 feral cats were captured and released, along with 24 feral cats being relocated during this 5-year timeframe (average of 18 per year). Take of feral or free-ranging cats by WS-Wyoming is considered to have no deleterious impact on the human environment because feral cats are not an indigenous component of the ecosystem in Wyoming. Therefore, no further analysis of population impacts is provided. As a non-native species in Wyoming, the removal of feral cats is generally considered to have a positive impact on the environment, especially for native birds (Coleman and Temple 1993, American Bird Conservancy 1997, Lepczyk et al. 2003). A summary of this impact analysis is provided in Table 3-2

3.1.1.7 Impact on White-tailed Jackrabbit Populations

The white-tailed jackrabbit (*Lepus townsendii*) is the most prevalent species of jackrabbit found in Wyoming. The white-tailed jackrabbit is distributed across the majority of the state, and is found in suitable habitats (shrub-steppe or grasslands) (Buskirk 2016). A study conducted in Uinta County, Wyoming reported densities of 18/mi^2. Given that white-tailed jackrabbits occupy approximately 80% of Wyoming and using half the reported density of 18/mi^2, a conservative estimate of the statewide white-tailed jackrabbit population would be 694,098 individuals. A survey of the literature did not reveal a reported sustainable harvest rate for white-tailed jackrabbits. Hacklander et al. (2008) reported there have only been a few studies on the sustainability of harvesting any lagomorph species. In a study of European hares, Marboutin et al. (2003) reported a sustainable harvest rate of 30%. While it is likely the sustainable harvest rate of white-tailed jackrabbits is similar to that reported for other lagomorph species, we will use the lowest reported threshold among all of the predator species analyzed (10%) as a conservative estimate.

White-tailed jackrabbits have the propensity to cause damage to agricultural resources, and have been reported to consume cultivated plants, especially alfalfa and winter wheat (Lim 1987). White-tailed jackrabbits are primarily targeted to reduce these types of problems. WS-Wyoming recorded average annual losses of $120 due to white-tailed jackrabbits during FY14-18. This damage was an even split between haystacks/bales and property damage to vehicles from white-tailed jackrabbits gnawing on electrical systems. White-tailed jackrabbits are managed as a predatory animal in Wyoming, and WDA is responsible for oversight of white-tailed jackrabbit management.

Direct Impacts: WS-Wyoming took an average of 23 white-tailed jackrabbits annually from FY14-18 in Wyoming, which is less than 0.003% of the estimated statewide white-tailed jackrabbit population. WS-Wyoming take ranged from 0 to 86 (Table 3-8). Under Alternative 1, we anticipate that WS-Wyoming would take less than 200 white tailed jackrabbits in any year, which represents less than 0.03% of the statewide population. As such, we anticipate no impact on the statewide white-tailed jackrabbit population. Local populations of white-tailed jackrabbits 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 white-tailed jackrabbit populations.

Table 3-8. Overview of white-tailed jackrabbit analysis.

Fiscal Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take[b]	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.[b]	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	8	ND	ND	694,098	0.001%	ND	10%	No
FY 2015	0	ND	ND	694,098	0%	ND	10%	No
FY 2016	20	ND	ND	694,098	0.003%	ND	10%	No
FY 2017	86	ND	ND	694,098	0.01%	ND	10%	No
FY 2018	0	ND	ND	694,098	0%	ND	10%	No
Average	**23**	**ND**	**ND**	**694,098**	**0.003%**	**ND**	**10%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]ND=Not Determined (no data available)
[c]Estimate derived by multiplying reported density by area of distribution

Indirect Impacts: 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 white-tailed jackrabbits expected to be taken (up to 0.03% of the estimated population), we do not expect any significant indirect impacts to white-tailed jackrabbits due to PDM conducted by WS-Wyoming.

Cumulative Impacts: Sportsman harvest and PDM by other individuals is not estimated by WDA. Even with no reporting of these types of take, the white-tailed jackrabbit population would not be negatively affected unless this additional harvest totaled more than 69,387 white-tailed jackrabbits each year, bringing the cumulative total above 69,410 (10% of the estimated population). This level of PDM or recreational take by other individuals is extremely unlikely, due to the level of effort which would be required. Moreover, occasional years with take above the 10% threshold would not impact the white-tailed jackrabbit population, as long as such take levels did not continue long-term. Using the conservative long-term sustainable harvest threshold of 10%, it is likely that the level of cumulative take occurring in Wyoming would have no impact on the statewide white-tailed jackrabbit population.

White-tailed jackrabbit populations are considered to be decreasing throughout their range, but are listed as a species of “least concern” according to the IUCN (Brown and Smith 2019).

3.1.1.8 Impact on Black-tailed Jackrabbit Populations

In Wyoming, the black-tailed jackrabbit (*Lepus californicus*) occurs in Laramie and Goshen Counties and between the eastern shore of Flaming Gorge Reservoir and Adobe Town Rim in Sweetwater County (Buskirk 2016). Populations of black-tailed jackrabbits have been studied in northern Utah and southern Idaho. Gross et al. (1974) reported populations are nearly cyclical, with fluctuations occurring every 8 years and densities of 31-261/mi^2 reported. Given that black-tailed jackrabbits inhabit approximately 10% of the state, multiplying the area of their range by the lowest population density of 31/mi^2 gives a conservatively estimated population of 273,265 black-tailed jackrabbits in Wyoming. As with other lagomorph species, information on sustainable harvest rates in the scientific literature is scarce, and a search by WS-Wyoming did not reveal any reported sustainable harvest rates for black-tailed jackrabbits. See section 3.1.1.7 for further discussion on sustainable harvest rates of other lagomorphs. For the purposes of this analysis we will use the lowest reported threshold among all of the predator species analyzed (10%) as a conservative estimate.

Black-tailed jackrabbits can cause significant damage to crops, and have been reported to preferentially consume barley and alfalfa (Fagerstone et al. 1980). Black-tailed jackrabbits are primarily targeted to reduce conflicts associated with agricultural resources. WS-Wyoming recorded no losses to black-tailed jackrabbits during FY14-18; however, they have been targeted during this period as a damage threat of haystacks/bales. Black-tailed jackrabbits are managed as a predatory animal in Wyoming, with WDA responsible for oversight of black-tailed jackrabbit management.

Direct Impacts: WS-Wyoming took an average of 18 black-tailed jackrabbits annually in Wyoming during FY14-18, which is less than 0.007% of the estimated statewide black-tailed jackrabbit population. WS-Wyoming take ranged from 0 to 89 (Table 3-9). Under Alternative 1, we anticipate that WS-Wyoming would take less than 200 black-tailed jackrabbits in any year, which represents approximately 0.07% of the statewide population. As such, we anticipate no impact on the statewide black-tailed jackrabbit population. Local populations of black-tailed jackrabbits 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 black-tailed jackrabbit populations.

Indirect Impacts: 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 black-tailed jackrabbits expected to be taken (up to 0.07% of the estimated population), we do not expect any significant indirect impacts to black-tailed jackrabbits due to PDM conducted by WS-Wyoming.

Cumulative Impacts: Sportsman harvest and PDM by other individuals is not estimated by WDA. Even with no reporting of these types of take, the black-tailed jackrabbit population would not be negatively affected unless this additional harvest totaled more than 27,308 black-tailed jackrabbits each year, bringing the cumulative total above 27,327 (10% of the estimated population). This level of PDM or recreational take by other individuals is extremely unlikely, due to the level of effort which would be required. Moreover, occasional years with take above the 10% threshold would not impact the black-tailed jackrabbit population, as long as such take levels did not continue long-term. Using the conservative long-term sustainable harvest threshold of 10%, it is likely that the level of cumulative take occurring in Wyoming would have no impact on the statewide black-tailed jackrabbit population.

Table 3-9. Overview of black-tailed jackrabbit analysis.

Fiscal Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take[b]	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.[b]	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	0	ND	ND	273,265	0%	ND	10%	No
FY 2015	89	ND	ND	273,265	0.03%	ND	10%	No
FY 2016	0	ND	ND	273,265	0%	ND	10%	No
FY 2017	0	ND	ND	273,265	0%	ND	10%	No
FY 2018	0	ND	ND	273,265	0%	ND	10%	No
Average	**18**	**ND**	**ND**	**273,265**	**0.006%**	**ND**	**10%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]ND=Not Determined (no data available)
[c]Estimate derived by multiplying reported density by area of distribution

Black-tailed jackrabbit populations are considered to be decreasing throughout their range, but are listed as a species of "least concern" according to the IUCN (Brown et al. 2019).

3.1.1.9 Impact on Porcupine Populations

Porcupines occur in forests and woodlands, and can be found statewide where woody vegetation occurs (Buskirk 2016). Porcupines are common in Wyoming, but abundance is highly variable (Buskirk 2016). Ilse and Hellgren (2001) reported a density of 4.92/mi^2 for porcupines on their Texas study area. This estimate was smaller than their estimate of 8.55/mi^2 in preferred habitats. Given that porcupines can occur statewide, multiplying the land area in Wyoming by half of the lower reported density estimate from Ilse and Hellgren (2001), gives a conservatively estimated population of 240,583 porcupines in Wyoming. A literature search by WS-Wyoming did not reveal any published sustainable harvest rates for porcupines. For the purposes of this analysis, we will use the lowest reported threshold among all of the predator species analyzed (10%) as a conservative estimate.

Porcupines can cause significant damage to standing trees and even injure livestock. WS-Wyoming recorded average annual losses of $1,313 due to porcupines during FY14-18 (Table 1-3), with most of the reported monetary loss attributed to injury of livestock. Porcupines are managed as a predatory animal in Wyoming, with WDA responsible for oversight of porcupine management.

Direct Impacts: WS-Wyoming took an annual average of 10 porcupines from FY14-18, which is approximately 0.004% of the estimated statewide porcupine population. WS-Wyoming take ranged from 3 to 21 (Table 3-10). Under Alternative 1, we anticipate that WS-Wyoming would take fewer than 100 porcupines in any year, which represents 0.04% of the statewide population. As such, we anticipate no impact on the statewide porcupine population. Local populations of porcupines 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 porcupine populations.

Indirect Impacts: 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 number of porcupines expected to be taken (up to 0.04% of the estimated population), we do not expect any significant indirect impacts to porcupines due to PDM conducted by WS-Wyoming.

Table 3-10. Overview of porcupine analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take[b]	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.[b]	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	21	ND	ND	240,583	0.009%	ND	10%	No
FY 2015	8	ND	ND	240,583	0.003%	ND	10%	No
FY 2016	10	ND	ND	240,583	0.004%	ND	10%	No
FY 2017	3	ND	ND	240,583	0.001%	ND	10%	No
FY 2018	6	ND	ND	240,583	0.002%	ND	10%	No
Average	**10**	**ND**	**ND**	**240,583**	**0.004%**	**ND**	**10%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]ND=Not Determined (no data available)
[c]Estimate derived by multiplying reported density by area of distribution

Cumulative Impacts: Sportsman harvest and PDM by other individuals is not estimated by WDA. Even with no reporting of these types of take, the porcupine population would not be negatively affected unless this additional harvest totaled more than 24,048 porcupines each year, bringing the cumulative total above 24,058 (10% of the estimated population). This level of PDM or recreational take by other individuals is extremely unlikely, due to the level of effort which would be required. Moreover, occasional years with take above the 10% threshold would not impact the porcupine population, as long as such take levels did not continue long-term. Using the conservative long-term sustainable harvest threshold of 10%, it is highly likely that the level of cumulative take occurring in Wyoming would have no impact on the statewide porcupine population.

Porcupine populations are considered to be stable throughout their range and are listed as a species of “least concern” according to the IUCN (Emmons 2016).

3.1.1.10 Impact on Bobcat Populations

The bobcat (*Lynx rufus*) is found throughout much of North America, excluding much of Canada and portions of the eastern United States. They are most abundant in southeastern states, with moderate densities in the western states (McCord and Cardoza 1982). In the western United States, bobcats are typically associated with rim rock and chaparral habitat, but can be found in other habitats, such as forests. They occur statewide in Wyoming but avoid open habitats and urban/suburban areas.

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 (McCord and Cardoza 1982, Rolley 1999).

Thompson et al. (1996) reported 19% as the long-term sustainable harvest threshold for bobcats in a variety of New Mexico ecozones. These ecozones included subalpine and montane coniferous forest, coniferous and mixed woodland, juniper savanna, montane scrub, Great Basin Desert scrub, and lava beds. Given the similarity of habitat types analyzed in New Mexico to those found in Wyoming, we will use this number for our analysis.

WGFD is responsible for the management of bobcats, which are designated as furbearing animals in the state. WS-Wyoming works with WGFD to provide PDM to reduce bobcat damage, especially to livestock. WS-Wyoming annually receives a Chapter 56 permit from the WGFD for the lethal take of furbearing animals. As a condition of this permit, WS-Wyoming annually reports activities that have occurred under this permit, including lethal take. This reporting process allows for quantification of population assessments and trajectory. Any furbearer taken by WS-Wyoming is quantified as part of WGFD analyses of wildlife populations.WS-Wyoming recorded an annual average of $950 in losses due to bobcat damage in Wyoming during FY14-18. Damage caused by bobcats was exclusively to livestock and domestic animals, especially pen-reared gamebirds.

WGFD has split the state into six Bobcat Management Areas and makes management decisions at the management area level. If bobcat mortality exceeds their thresholds in any area or on any scale, WGFD has the authority and intent to change bobcat management rules, such as season length, take methods, and bag limits. WS-Wyoming take is included in cumulative mortality analyzed annually by WGFD, and the State's management objectives are not influenced by WS-Wyoming. As such, WS-Wyoming has little or no ability to impact bobcat populations in Wyoming. In the interest of transparency, however, we have analyzed direct, indirect, and cumulative impacts.

Direct Impacts: WS-Wyoming took an annual average of 7 bobcats from FY14-18. WS-Wyoming take ranged from 4 to 11 (Table 3-11). Under Alternative 1, we anticipate that WS-Wyoming would take fewer than 40 bobcats in any year. As such, we anticipate no impact on the statewide bobcat population. Local populations of bobcats 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 bobcat populations.

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-Wyoming might take under Alternative 1, any indirect impacts of such take would be negligible.

Cumulative Impacts: Sportsman harvest ranged from 1,140 to 2,193, with an average of 1,468 annually during FY14-18 (Table 3-11, Pers. Comm. G. Frost September 27, 2019, e-mail). 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.

Table 3-11. Overview of bobcat analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	11	1,140	1,151	ND	ND	ND	19%	No
FY 2015	5	1,164	1,169	ND	ND	ND	19%	No
FY 2016	7	1,397	1,406	ND	ND	ND	19%	No
FY 2017	4	2,189	2,193	ND	ND	ND	19%	No
FY 2018	10	1,452	1,462	ND	ND	ND	19%	No
Average	**7**	**1,468**	**1,476**	**ND**	**ND**	**ND**	**19%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]Data from WGFD.
[c]ND=Not Determined (no data available)

Cumulative take averaged 1,476 bobcats, with a range of 1,169 to 2,193. Under Alternative 1, we anticipate cumulative take to vary with fur prices, but we don't expect it to exceed the 19% 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.

Bobcat populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (Kelly et al. 2016).

3.1.1.11 Impact on Virginia Opossum Populations

The Virginia opossum is known to occur in the riparian zone of the North Platte River from the Nebraska state line to Guernsey Reservoir in Platte County (Buskirk 2016). In 1965, there was only one record of a Virginia opossum in Wyoming. Since then, the opossum's range has expanded due to land-use changes, including agriculture and a warming climate (Buskirk 2016). This species is most abundant in riparian areas, but also inhabits deciduous woodlands, cottonwood forests, pinyon-juniper woodlands, farmlands, old fields, grasslands, marshlands, agricultural and forested edges, and desert plains. Opossums are omnivorous and have a wide-ranging diet. Females breed in their first year and 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. The portion of the North Platte River riparian zone in which Virginia opossums are known to occur is approximately 61 miles long. Reported Virginia opossum density for other areas ranges from 1.3/mi^2 to 20.2/mi^2 with an average of 10.1/mi^2 (Seidensticker et al. 1987). Assuming the North Platte River riparian zone averages a half mile wide from the centerline of the river, and using the average reported density, given the high quality of habitat, we believe that a statewide population of approximately 616 opossums is a conservative estimate.

WGFD is responsible for the management of Virginia opossums. The Virginia opossum is designated as a nongame animal in Wyoming but can be taken according to the provisions of the Wyoming Weed and Pest Control Act of 1975 (WGFC Chapter 52 Regulations). WS-Wyoming has targeted Virginia opossums for damage to grain crops, such as corn.

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) are maintained (Seidensticker et al. 1987). 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.

Direct Impacts: WS-Wyoming lethally took an average of 4 opossums annually during FY14-18, with a high of 10 in FY10 (Table 3-12). Under Alternative 1, we anticipate that WS-Wyoming would continue to take a few opossums annually, likely fewer than 20 in any year. This represents 3.25% of the opossum population, which would have negligible impacts on local opossum populations, and no impact on the statewide population.

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 extremely low numbers of Virginia opossums WS-Wyoming might take under Alternative 1, any indirect impacts of such take would be negligible.

Cumulative Impacts: Sportsman harvest and PDM by other individuals is not estimated by WGFD. Even with no reporting of such take, the Virginia opossum population would not be negatively affected unless this additional harvest totaled more than 42 opossums each year, bringing the cumulative total above 62 (10% of the estimated population). This level of PDM or recreational take by other individuals is extremely unlikely, due to opossum's limited distribution in the state and the lack of value of their pelts. Moreover, occasional years with take above the 10% threshold would not impact the opossum population, as long as such take levels did not continue long-term. Using the conservative long-term sustainable harvest threshold of 10%, it is likely that the level of cumulative take occurring in Wyoming would have no impact on the statewide Virginia opossum population.

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 (Perez-Hernandez et al. 2016)

Table 3-12. Overview of Virginia opossum analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take[b]	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.[b]	Long-Term Sustainable Harvest Rate	Significant Impact?
FY 2014	2	ND	ND	616	0.16%	ND	10%	No
FY 2015	0	ND	ND	616	0%	ND	10%	No
FY 2016	0	ND	ND	616	0%	ND	10%	No
FY 2017	10	ND	ND	616	1.62%	ND	10%	No
FY 2018	7	ND	ND	616	1.13%	ND	10%	No
Average	**4**	**ND**	**ND**	**616**	**0.58%**	**ND**	**10%**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]ND=Not Determined (no data available)
[c] Estimate derived by multiplying reported density by area of distribution

3.1.1.12 Impact on Black Bear Populations

Black bears (*Ursus americanus*) can be found throughout much of North America, including the Rocky Mountains. In Wyoming, black bears are found throughout the mountain ranges in the northwestern part of the state, including the Snowy, Sierra Madre, Laramie Peak, and Uinta ranges (Wyoming Game and Fish Department 2007). They occasionally are also found dispersing through unforested areas .(Buskirk 2016) Black bears can live up to 25 years or more (Rogers 1976), and eat a variety of foods, including grass, fruits, nuts, carrion, livestock, mammals, insects, bees (especially the larvae) 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 neonates and livestock than was previously believed (Rayl et al. 2015, Leblond et al. 2016b). 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 1987). Juvenile black bear annual mortality ranges between 20 and 70 percent, with orphaned cubs exhibiting the highest mortality (Kolenosky and Strathearn 1987). 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 1987). In the southwestern U.S., black bear population densities have been documented at 1/mi^2 (LeCount 1982). Grogan and Lindzey (1999) reported a mean population density for black bears in the Medicine Bow Mountains of Wyoming to be 0.064/mi^2. Currently WGFD is conducting a systematic survey that estimates black bear densities in localized populations in order to derive a more accurate estimate of abundance and density at a statewide level, however at the time of assessment, there is not enough data for an accurate estimate. Despite that, the overall population of black bears in most areas is stable to increasing.

Black bears are managed as trophy game animals in Wyoming and, as such, WGFD has management authority and is responsible for compensation for livestock losses. WGFD is the primary responding agency to black bear damage complaints in Wyoming. However, WGFD sometimes requests WS-

Wyoming to take black bears or investigate damage claims due to killing or injury of livestock and could also do so for the protection of health and human safety or natural resources. WS-Wyoming also receives calls regarding black bear damage from individuals, but all damage management work is coordinated with WGFD. WS-Wyoming annually receives a Chapter 56 permit from the WGFD for the lethal take of trophy game animals. As a condition of this permit, WS-Wyoming annually reports activities that have occurred under this permit, including lethal take. This reporting process allows for quantification of population assessments and trajectory. Any trophy game animal taken by WS-Wyoming is quantified as part of WGFD analyses of wildlife populations. WS-Wyoming recorded an annual average of $5,271 in damage due to black bears during FY14-18. All of this damage was attributed to livestock losses. WS-Wyoming also investigated one bear sighting near a developed area for health and human safety purposes.

Clark and Smith (1994) estimated a sustainable harvest rate of 26% for a location in Arkansas with good bear habitat, though they noted that this level may not be able to be maintained indefinitely. Other published rates have been as low as 14.2-15.9% (Miller 1990). For this analysis, we will use the lowest reported sustainable harvest threshold (~14%) as a conservative estimate.

Direct Impacts: WS-Wyoming lethally took an average of 2 black bears per year during FY14-18, with a range of 0 (FY17) to 4 (FY18) (Table 3-13). Under Alternative 1, we anticipate a maximum of 10 black bears taken by WS-Wyoming in a given year. 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 3-13. Overview of black bear analysis.

Year	WS Take[a]	Sportsman Harvest[b]	Other Take[c]	Cumulative Take	Estimated Population[d]	WS Take % of Pop.	Cumulative Take % of Pop.	Significant Impact?
FY 2014	2	399	8	409	ND	ND	ND	No
FY 2015	2	453	10	465	ND	ND	ND	No
FY 2016	1	451	11	463	ND	ND	ND	No
FY 2017	0	467	8	475	ND	ND	ND	No
FY 2018	4	457	13	474	ND	ND	ND	No
Average	**2**	**445**	**10**	**457**	**ND**	**ND**	**ND**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]Data from WGFD.
[c]Lethal removals by WGFD
[d]ND=Not Determined (no data available)

Some local black bear populations might be temporarily reduced due to WS-Wyoming PDM. Such decreases would be localized, temporary, and would not impact the statewide black bear population. These effects would be at the request of WGFD. WS-Wyoming's take of black bears is tied to requests by WGFD to remove problem bears. In the absence of these actions by WS-Wyoming, problem bears would likely still be removed either by WGFD, agricultural producers or their agents. Wyoming Statute 23-3-115 allows property owners, their employees, or lessees of property to immediately take any black bear responsible for damage to private property. WGFD intensively manages black bears and routinely evaluates annual harvest rates.

Indirect Impacts: The level of black bear take by WS-Wyoming 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 bears due to WS-Wyoming PDM.

Cumulative Impacts: Sportsman harvest averaged 445 black bears per year, with a range of 399 to 467 (Pers. Comm. G. Frost September 27, 2019, e-mail). Other take included an average of 10 lethal management removals per year by WGFD (Pers. Comm. D. Thompson February 27, 2020, e-mail) Cumulative take ranged from 409 to 475, with an average of 457 per year (Table 3-13). Under Alternative 1, we anticipate cumulative take not to exceed 600 black bears in any year. 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 WGFD to achieve such changes. In these cases, the impact is the desired outcome, and the participation of WS-Wyoming is considered beneficial to achieving the desired outcome. PDM take by WS-Wyoming might contribute to these changes whenever the decisions are based on biologically and ecologically sound principles, the goals are in accordance with the management objectives, 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.

WGFD may decide to conduct management actions to achieve a decrease in a local black bear population if it determines that the population is above the carrying capacity. WS-Wyoming's involvement in the take of black bears in such a scenario would be considered beneficial to the environment. Also, WS-Wyoming's involvement should actually *benefit* the ability of WGFD to control black bear mortality because WS-Wyoming is more likely to target the correct problem bear, whereas private resource owners may not as readily be able to reliably identify and kill target bears.

WGFD has management authority over black bears in Wyoming, and the decision of WGFD 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 (Garshelis et al. 2016).

3.1.1.13 Impact on Feral Dog Populations

Feral and free-roaming dogs are common in Wyoming. Requests for assistance with feral dogs are approved by the appropriate state or local agency, as regulated by Wyoming State laws. WS-Wyoming recorded an average of $2,960 in annual losses due to feral dogs during FY14-18. These were losses to livestock, including an average of 26 animals killed or injured per year.

Direct, Indirect, and Cumulative Impacts: WS-Wyoming took an annual average of <1 feral dog in FY14-18, with a maximum take of three feral dogs in FY18. Under Alternative 1, we anticipate that WS-Wyoming may take up to 5 feral dogs in any year. Take of feral or free-ranging dogs by WS-Wyoming is considered to have no deleterious impact on the human environment because feral dogs are not an indigenous component of the ecosystem in Wyoming. Therefore, no further analysis of population impacts is provided. As a non-native species in Wyoming, 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.

3.1.1.14 Impact on Mountain Lion Populations

Mountain lions (*Puma concolor*) have an extensive distribution across western North America, including statewide in Wyoming. This species is known by several other names, including panther, puma, catamount, and cougar. Mountain lions occupy a range of environments in Wyoming, from desert to alpine zones, indicating a large degree of adaptability. They are closely associated with deer, elk, and other large hoofed mammals 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 summer following about a 90 day gestation period (Wyoming Game and Fish Department 2006, Jansen and Jenks 2012, Elbroch et al. 2015). Litter sizes range from one to six, with an average of two or three.

WGFD manages mountain lions as a trophy game animal in Wyoming and is responsible for compensation for livestock losses. Owners of property, their employees, and property lessees may immediately take a mountain lion causing property damage (Wyoming Statute 23-3-115). WGFD is the primary response agency to mountain lion damage complaints in Wyoming. However, WGFD sometimes requests assistance from WS-Wyoming removing mountain lions or investigating damage claims for livestock depredations when the need arises and for the protection of health and human safety as well as natural resources. WS-Wyoming annually receives a Chapter 56 permit from the WGFD for the lethal take of trophy game animals. As a condition of this permit, WS-Wyoming annually reports activities that have occurred under this permit, including lethal take. This reporting process allows for quantification of population assessments and trajectory. Any trophy game animal taken by WS-Wyoming is quantified as part of WGFD analyses of wildlife populations

In the Bighorn Mountains of Wyoming, resident mountain lions were estimated to have a density of 3.8/100mi^2 and mountain lions of all residency statuses were estimated at a density of 10/100mi^2 (Logan et al. 1986). Another Wyoming study in the Medicine Bow Mountains reported an independent mountain lion density of 6-8.7/100mi^2 (Anderson Jr. and Lindzey 2005). Using molecular methods Anderson Jr. et al. (2004) estimated Wyoming's mountain lion population to be 1,800-4,500 individuals.

Anderson Jr. and Lindzey (2005) conducted a study that evaluated mountain lion population recruitment and retention following human caused decrease in the Snowy Range of southeastern Wyoming. Their study included a treatment phase in which the mountain lion population in their study area was reduced through increased hunter harvest over a period from autumn of 1998 through spring of 2000. This treatment phase was followed by three years of reduced harvest (about half of that which occurred during the treatment phase). Anderson Jr. and Lindzey (2005) determined this three-year period of reduced harvest was enough time for the mountain lion population to recover from the increased harvest. Relative to the pretreatment phase of the study, treatment phase harvest resulted in a reduction in subadult harvest, an initial increase followed by a reduction in adult male harvest, and a steady increase in adult female harvest. Anderson Jr. and Lindzey (2005) demonstrated an index to mountain lion population change can be derived by using a combination of the sex ratios combined with age class data of mountain lions harvested from a population. This information can be used to adaptively manage cougar populations and serves as the basis for the WGFD's Mountain Lion Management Plan.

Given that WGFD sets management objectives based on local and regional biological *and* social considerations (Wyoming Game and Fish Department 2006), we will use 11% as the sustainable harvest rate for this analysis, but recognize, at the discretion of WGFD, that some years the cumulative harvest rate may be above 11%. WGFD will sometimes allow a greater percentage of mountain lions to be harvested in order to reach management goals. WGFD intensively manages mountain lion populations by adjusting annual harvest rates as needed. WGFD may decide to affect 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-Wyoming 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-Wyoming's involvement in the take of mountain lions in such a scenario would not be considered a significant impact.

The majority of mountain lion incidents involve depredation of livestock, pets, and sometimes people. WS-Wyoming recorded an average of $13,174 per year in losses (7% of all predator damage and second only to coyotes) to livestock, pets, property, and natural resources. Lions killed or injured an average of 75 livestock and one pet annually in FY14-18, as well as injuring one guard animal within this five- year timeframe. Mountain lion predation on wildlife species such as bighorn sheep and mule deer has created concern in some areas of the state. WS-Wyoming recorded one instance of predation on bighorn sheep in FY14-18.

Direct Impacts: WS-Wyoming took an average of less than one mountain lion per year (0.008% of the population), with a range of 0 to 1 during FY14-18 (Table 3-13). Under Alternative 1, mountain lion take by WS-Wyoming may increase over these levels due to projects to protect ungulates from mountain lion predation. We anticipate that WS-Wyoming would take no more than 10 mountain lions in any year. 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. WS-Wyoming's take of mountain lions is generally in response to requests by WGFD to remove problem lions. In the absence of these actions by WS-Wyoming, lions would likely still be removed either by WGFD, property owners, their employees, or property lessees.

In locations where mountain lion populations are being managed by WGFD in order to protect ungulate populations, local mountain lion populations might be moderately impacted as an objective. However, these moderate impacts would be temporary, and would not impact the statewide population. Local harvest rates 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, Anderson Jr. and Lindzey 2005).

Under Alternative 1, there would be no significant impacts to either local or statewide mountain lion populations.

Indirect Impacts: Intentional high harvest rates might be implemented by WGFD to reduce local mountain lion populations based on regional management objectives. Depending on the degree of reduction of the lion population, recovery to the original population level may take 1-3 years. Due to demographic factors of mountain lion populations, such as 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-Wyoming.

Table 3-14. Overview of mountain lion analysis.

Fiscal Year	WS Take[a]	Sportsman Harvest[b]	Other Take[c]	Cumulative Take	Estimated Population[d]	WS Take % of Pop.	Cumulative Take % of Pop.	Significant Impact?
FY 2014	1	266	3	270	ND	ND	ND	No
FY 2015	0	248	3	251	ND	ND	ND	No
FY 2016	0	255	1	256	ND	ND	ND	No
FY 2017	1	282	1	284	ND	ND	ND	No
FY 2018	0	330	8	338	ND	ND	ND	No
Average	**<1**	**276**	**3**	**280**	**ND**	**ND**	**ND**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]Data from WGFD.
[c]Lethal removals by WGFD
[d]ND=Not Determined (no data available)

<u>Cumulative Impacts</u>: Sportsman harvest averaged 276 mountain lions, with a range of 248 to 330 (Table 3-13, Pers. Comm. G. Frost September 27, 2019, e-mail). Cumulative take averaged 280 mountain lions, with a maximum of 338 in FY18. (Table 3-13). This cumulative lion take during this 5-year period would be expected to maintain the mountain lion population at or near carrying capacity.

Mountain lion populations are managed intensively by WGFD, which may decide to affect a decrease in the population by modifying annual harvest rates if it determines a given population to be too high. WS-Wyoming's involvement in the take of mountain lions in such scenarios 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-Wyoming's involvement should actually be *beneficial* because it will help WGFD to achieve its management goals to maintain viable populations while reducing the potential for conflict, especially livestock depredation. It will also improve the ability of WGFD to control lion mortality because WS-Wyoming is more likely to correctly target problem lions, whereas private resource owners may not reliably kill the target lion.

WGFD has management objectives for the 32 mountain lion hunt areas (local scale) and five mountain lion management units (regional scale) in Wyoming. Hunter harvest and non-hunter mortality objectives have been set. WGFD uses a 3-year average of harvest to estimate mortality (hunter and non-hunter), determine the harvest potential for a mountain lion hunt area, and to set the next season's limits. WS-Wyoming take is included in the WGFD analyses. WGFD can and will reduce the limit 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 relatively stable cumulative mountain lion take. Cumulatively under Alternative 1, we anticipate moderate short-term impacts to some localized mountain lion 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 discretion of, and under the control of, WGFD, as discussed above. WS-Wyoming would have no authority and no ability to alter these impacts on mountain lions, and WS-Wyoming's contribution to such impacts would be negligible.

WGFD has management authority over the management of mountain lions in Wyoming, and the decision of WGFD 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 (Nielsen et al. 2015).

3.1.1.15 Impact on Mink Populations

WGFD is the agency responsible for the management of mink (*Neovison vison*), which are classified as furbearing animals in Wyoming. WS-Wyoming annually receives a Chapter 56 permit from the WGFD for the lethal take of furbearing animals. As a condition of this permit, WS-Wyoming annually reports activities that have occurred under this permit, including lethal take. This reporting process allows for quantification of population assessments and trajectory. Any furbearer taken by WS-Wyoming is quantified as part of WGFD analyses of wildlife populations. Mink are found across much of northern North America and broadly across Wyoming within suitable habitats (Buskirk 2016). 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).

Damage from mink is usually associated with poultry and fish predation. From FY14-18, WS-Wyoming recorded an annual average of 5 chickens lost to mink, for an average annual loss of $96. 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%).

Direct Impacts: WS-Wyoming took one mink during FY14-18. Under Alternative 1, it is unlikely that WS-Wyoming would take many mink, but it is possible that an occasional mink may be taken, up to 5 mink in any year, which is expected to result in no impact to mink, either locally or statewide.

Table 3-15. Overview of mink analysis.

Fiscal Year	WS Take[a]	Sportsman Harvest[b]	Cumulative Take	Estimated Population[c]	WS Take % of Pop.	Cumulative Take % of Pop.	Significant Impact?
FY 2014	0	206	206	ND	ND	ND	No
FY 2015	0	180	180	ND	ND	ND	No
FY 2016	0	112	112	ND	ND	ND	No
FY 2017	1	157	158	ND	ND	ND	No
FY 2018	0	128	128	ND	ND	ND	No
Average	**<1**	**157**	**157**	**ND**	**ND**	**ND**	**No**

[a]WS Take is all lethal take, including nontarget take.
[b]Data from WGFD.
[c]ND=Not Determined (no data available)

Indirect Impacts: We are not aware of any significant indirect impacts to mink due to PDM conducted by WS-Wyoming. The infrequent take under Alternative 1 would be unlikely to affect immigration rates or distances, fecundity, or age structure.

Cumulative Impacts: Sportsman harvest was estimated at a low of 112 in FY16, and a high of 206 in FY14 (Pers. Comm. G. Frost September 27, 2019, e-mail). The average sportsman harvest in FY14-18 was 157 per year (Table 3-15). 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 500 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 would be 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.

Mink populations are considered to be stable throughout their range, and they are listed as a species of "least concern" according to the IUCN (Reid et al. 2016b).

3.1.1.16 Impact on Grizzly Bear Populations

Grizzly bears occur throughout parts of the northwestern United States, western Canada, and Alaska. In Wyoming, grizzly bears are found throughout the mountain ranges in the northwestern part of the state in portions of the Greater Yellowstone Ecosystem. Grizzly bears are solitary omnivores and are capable of living in a wide variety of habitats, as evidenced by historic accounts of statewide distribution (Buskirk 2016). Grizzly bear diets are highly varied and shift seasonally. Gunther et al. (2014)conducted a review of grizzly bear studies in the Greater Yellowstone Ecosystem and found grizzly bears have been documented to consume 175 plant, 37 invertebrate, 34 mammal, 7 fungi, 7 bird, 4 fish, 1 amphibian, and 1 algae species. Gunther et al. (2014) also reported the most frequently detected items in grizzly bear diets in their study area were graminoids, ants, whitebark pine seeds (*Pinus albicaulis*), clover (*Trifolium spp.*), and dandelion (*Taraxacum spp.*). On a temporal basis the most consistently used foods were graminoids, ands, whitebark pine seeds, clover, elk, thistle (*Cirsium spp.*), and horsetail (*Equisetum spp.*). Fortin et al. (2013) conducted a study of the adjustability of the grizzly bear diet in Yellowstone National Park. The results of their study indicated grizzly bears are capable of finding alternate food sources when primary food sources are scarce, as evidenced by an increase of false truffles (*Rhizopogon* spp.) in female grizzly bear diets when whitebark pine seed abundance is low. Female grizzly bears reach reproductive maturity at 5-7 years (Buskirk 2016). Density estimates for grizzly bears in the Greater Yellowstone Ecosystem have been reported to be 36-46/1,000mi^2 (Schwartz et al. 2003). It is estimated there were 709 grizzly bears in the Greater Yellowstone Ecosystem in 2018 (Interagency Grizzly Bear Study Team 2019).

Wyoming state statute defines grizzly bears as trophy game animals. However, the Yellowstone Distinct Population Segment is federally listed as threatened under the Endangered Species Act. Grizzly bears were originally listed as a threatened species on July 28, 1975 (40 FR 31734). On March 29, 2007 the USFWS issued a final rule (72 FR 14866) creating the Yellowstone DPS and removing the population from the Federal List of Endangered and Threatened Wildlife. On September 21, 2009 a Montana District Court issued an order vacating the delisting rule (72 FR 1486) issued by the USFWS, thus returning grizzly bears to threatened status under the ESA. Since the court vacated the entire delisting rule, the Yellowstone DPS status was also dissolved and all grizzly bears in the lower 48 states returned to their listing as threatened. The USFWS issued a final rule on March 26, 2010 in compliance with the court order (72 FR 14866). On June 30, 2017 the USFWS again issued a final rule establishing a DPS of grizzly bears for the Greater Yellowstone Ecosystem and removing the threatened status of the DPS. On September 24th, 2018 a Montana District Court issued an order vacating the delisting rule that returned the GYE DPS of grizzly bears to threatened status. The USFWS issued a final rule (84 FR 37144) on July 31, 2019 to comply with the court order.

In 2014 the USFWS issued a Grizzly Bear Special 4(D) Rule (50 CFR 17.40). This rule allows for the take of grizzly bears in self-defense or in defense of others. The rule also allows for the take of nuisance grizzly bears if a grizzly bear is constituting a demonstrable but non immediate threat to human safety or committing significant depredations to lawfully present livestock, crops, or beehives. The take of nuisance bears can only be conducted by authorized Federal, State, or Tribal authorities.

In Wyoming, WGFD is the lead agency tasked with responding to nuisance grizzly bear issues. As such, WGFD is the agency that coordinates with USFWS for direction on grizzly bear conflicts. Any involvement with direct control operations by WS-Wyoming in relation to grizzly bear conflicts has been and will be at the request of WGFD. We do recognize however, that in the unforeseeable absence of WGFD, WS-Wyoming could consult directly with USFWS if required.

WS-Wyoming recorded an annual average of $12,366 in damage due to grizzly bears during FY14-18. Damages from grizzly bears were attributed entirely to livestock losses. WS-Wyoming also investigated one bear sighting near a developed area for human health and safety purposes.

Direct Impacts: During FY14-18, WS-Wyoming did not take any grizzly bears. Under Alternative 1, we anticipate a maximum of 2 grizzly bears taken by WS-Wyoming in any given year. This corresponds to less than 0.3% of the estimated Greater Yellowstone Ecosystem grizzly bear population. This level of grizzly bear take is well below the reported sustainable mortality limits for grizzly bears. Interagency Grizzly Bear Study Team (2012) estimated female grizzly bears and dependent young could sustain mortality levels of 7.6% of the estimated population and males could sustain 15% of the estimated population to maintain a stable to increasing population. WS-Wyoming take of grizzly bears is expected to have no impact on statewide grizzly bear populations. Impacts to local grizzly bear populations would be negligible.

Some local grizzly bear populations might be temporarily decreased due to WS-Wyoming PDM. Such decreases would be localized and temporary and would not impact the statewide grizzly bear population. These effects would be attributable to requests for assistance from WGFD under the guidance of the USFWS. WS-Wyoming's take of grizzly bears is generally in response to requests by WGFD to remove problem bears. In the absence of these actions by WS-Wyoming, problem bears would likely still be removed by WGFD.

Indirect Impacts: The maximum anticipated level of grizzly bear take by WS-Wyoming (up to 0.7% of the estimated Greater Yellowstone Ecosystem population) would not be expected to result in any significant impacts to grizzly bear immigration rates, fecundity, or age structure at local, distinct population segment or statewide population levels. We are not aware of any other indirect impacts to grizzly bears due to WS-Wyoming PDM.

Cumulative Impacts: WS-Wyoming did not lethally take any grizzly bears during FY14-18. There was also no sportsman harvest of grizzly bears given their status (federally threatened) under the Endangered Species Act. Therefore, cumulative take was solely comprised of WGFD lethal management removals that were conducted in coordination with the USFWS. WGFD lethal management removals ranged from 6 to 32, with an average of 18 grizzly bears removed per year during this 5-year period (Pers. Comm. D. Thompson, February 27, 2020, e-mail). This corresponds to an average of 2.5% of the estimated grizzly bear population in the Greater Yellowstone Ecosystem.

The USFWS has management authority over grizzly bears in Wyoming, and the decision of WGFD in consultation with USFWS to remove problem grizzly bears would not 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 grizzly bear population under Alternative 1.

Grizzly bear populations are considered to be stable to increasing throughout their range in the GYE and are listed as a species of "least concern" according to the IUCN (McLellan et al. 2017).

3.1.1.17 Impact on Spotted Skunk Populations

Two species of spotted skunks inhabit Wyoming, the eastern spotted skunk (*Spilogale putorius*) and the western spotted skunk (*Spilogale gracilis*). The species boundary separating eastern and western spotted skunks runs from the eastern Bighorn Mountains to Laramie County (Buskirk 2016). However, distribution throughout the state of the species are debated. Spotted skunks are found in diverse habitats over small portions of the state with evidence suggesting that the western species is more prone to occupy rocky areas, while the eastern species is more common in the plains (Buskirk 2016). 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. They often take advantage of food and cover resources in agricultural areas. Spotted skunks make their dens in cracks and crevices among rocks, in 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. Management authority for spotted skunks lies with WDA and they are classified as predatory animals. Little information is available on spotted skunk densities. One study in Iowa found an average density of 5.7/mi^2 in favorable habitat (Crabb 1948). If spotted skunk densities are conservatively estimated at the lowest reported density for striped skunks (0.85/mi^2), the populations could be conservatively estimated for eastern spotted skunks at approximately 27,709 and 55,419 for western spotted skunks.

We know of no published sustainable harvest threshold data for eastern or 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.

Direct Impacts: WS-Wyoming rarely receives complaints for damage due to spotted skunks, and they are rarely targeted by WS-Wyoming for PDM. WS-Wyoming did not take any spotted skunks during FY14-18, 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 (0.009% of the estimated population). We also anticipate the infrequent take of eastern 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 or eastern spotted skunk populations locally, and no impact on the statewide populations.

Indirect Impacts: It is extremely unlikely that the infrequent take of western or eastern spotted skunks could cause any indirect impacts to the species, including changes in dispersal rates, dispersal distances, fecundity, or age-structure. PDM conducted by WS-Wyoming would not have any indirect effects on these species.

Cumulative Impacts: WDA does not keep records on sportsman harvest, or the number of spotted skunks taken by other individuals engaged in PDM activities. Under alternative 1, spotted skunks may be taken occasionally by WS-Wyoming, sportsmen, or other entities conducing PDM activities. Given the secretive nature of spotted skunks and that very few, if any, sportsmen target spotted skunks, we do not expect cumulative take to be greater than the 10% sustainable harvest rate of the estimated spotted skunk populations. Cumulative take of spotted skunks is expected to have a negligibly low impact on the statewide populations. 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 (Cuaron et al. 2016). Throughout their range, eastern spotted skunk populations are considered to be decreasing and are listed as a "vulnerable" species according to the IUCN (Gompper and Jachowski 2016).

The plains spotted skunk (*Spilogale putorius interrupta*) is a subspecies of the eastern spotted skunk. In response to a filed petition, the USFWS issued a 90-day finding on December 4, 2012 indicating the plains spotted skunk may be warranted for listing under the Endangered Species Act. This 90-day finding does not mean the USFWS has decided it is appropriate to give the plains spotted skunk federal protection under the Endangered Species Act, but rather triggers a more thorough status review of the species in which the USFWS could find listing of the species as warranted or not warranted. WS-Wyoming rarely targets spotted skunks and has not lethally taken an eastern or western spotted skunk in over ten years. Given that spotted skunks are defined as predatory animals under Wyoming statutes, WS-Wyoming would target spotted skunks if assistance for spotted skunk damage was requested by a cooperator. WS-Wyoming will continue to monitor the status of the plains spotted skunk and will consult with the USFWS as appropriate should their status change based on their findings.

3.1.1.18 Impact on Weasel Populations

Both long-tailed weasels (*Mustela frenata*) and short-tailed weasels (*Mustela erminea*) are found in Wyoming. WGFD has management authority over weasels, which are classified as furbearing animals. WS-Wyoming annually receives a Chapter 56 permit from the WGFD for the lethal take of furbearing animals. As a condition of this permit, WS-Wyoming annually reports activities that have occurred under this permit, including lethal take. This reporting process allows for quantification of population assessments and trajectory. Any furbearer taken by WS-Wyoming is quantified as part of WGFD analyses of wildlife populations The long-tailed weasel is common throughout the state and is found in a wide variety of habitats, but particularly in grassy areas, with high populations of mice and voles (Buskirk 2016).

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).

The short-tailed weasel is found at higher elevations in Wyoming (covering about 20% of the state) in mixed coniferous forest, alpine tundra, with limited distribution in arid shrub-steppe habitats (Buskirk 2016)

Published densities for short-tailed weasels vary from 10/mi^2 to 16/mi^2 in preferred habitats (Fagerstone 1999).

Both of these weasel species primarily feed on small mammals and some birds. WS-Wyoming has historically received few damage complaints for weasels, which have invariably been for the long-tailed weasel, and most always for poultry predation. During FY14-18, WS-Wyoming recorded 1 chicken loss to weasels valued at $7.

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.

Direct Impacts: WS-Wyoming did not take any long-tailed weasels or short-tailed weasels during FY14-18. Damage was recorded once in FY14-18 and could occur in the future. Under Alternative 1, it is unlikely that WS-Wyoming would take any weasels, but they may be taken infrequently, up to 2 long-tailed weasels, and 2 short-tailed weasels 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-Wyoming. WS-Wyoming did not take any weasels in FY14-18, 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: From FY14-18, sportsman harvest was estimated at a low of 40 in FY15, and a high of 93 in FY14, with an average of 56 across all years in this five-year time frame (Pers. Comm. G. Frost September 27, 2019, e-mail). WGFD does not differentiate between long-tailed and short-tailed weasels is harvest estimates; therefore, for the purposes of this analysis, we will use the total weasel harvest for the analysis for each species of weasel. Under Alternative 1, sportsmen may harvest some in the future, and WS-Wyoming could take a weasel infrequently under damage-causing scenarios. We anticipate maximum cumulative harvest of 100 long-tailed weasels and 100 short-tailed weasels, which are well below estimated sustainable 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 (Helgen and Reid 2016b, Reid et al. 2016a)

3.1.1.19 Summary of Direct, Indirect, and Cumulative Impacts to target Wildlife Populations under Alternative 1:

Direct Impacts: Lethal take of target predators by WS-Wyoming 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-Wyoming PDM take of target mammalian predator species statewide:

- less than 0.1% of the population of most predator species, including, white-tailed jackrabbit, black tailed jackrabbit, porcupine, western spotted skunk, eastern spotted skunk.
- less than 0.3% of the populations of striped skunk, and grizzly bear.
- less than 0.7% of the red fox population.
- less than 3% of the raccoon population.
- less than 4% of the Virginia opossum population.
- less than 18% of the coyote population.
- less than what would be necessary to cause a negative impact on badger, bobcat, black bear, mountain lion, mink, and weasel populations based on WGFD quantification of population assessments and trajectory.

WS-Wyoming 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 and dogs would be beneficial, because they are not indigenous components of the ecosystem in Wyoming.

Indirect impacts: These might include increased localized immigration rates and distances, and increased fecundity for coyotes, black bears, and mountain lions, in locations where WS-Wyoming might temporarily decrease local populations. There might also be a younger age structure in local coyote populations in locations where WS-Wyoming 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-Wyoming.

Cumulative Impacts: Many native mammalian predators are managed by WGFD on a sustainable basis, and the largest contributor to cumulative take for these target predator species is sportsman harvest. For species that are managed by WDA as predatory animals, it is unlikely the amount of sportsman harvest and alternative sources of PDM take are high enough to surpass sustainable harvest thresholds, given the collective amount of effort that would be required. WS-Wyoming PDM take is a very minor component of cumulative take for all species analyzed, with the exception of coyotes. Despite WS-Wyoming take making up a large percentage of the cumulative take of coyotes, the cumulative take percentage of the population is still more than five times lower than the long-term sustainable harvest rate. 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-Wyoming Only for Corrective Control

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS-Wyoming take of most target predator species would be about the same as that under Alternative 1. The one exception would be coyotes because they are typically the only species for which WS-Wyoming conducts preventive PDM. Damage from all other predator species is of relatively low occurrence, and temporally and spatially unpredictable. For all species except coyotes, WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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 experienced 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 such control (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-Wyoming. Much of the WS-Wyoming 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. The end result under Alternative 2 would be slightly lower take of coyotes for PDM.

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 under Alternative 1. Under Alternative 2, there would be no impact on statewide populations of target predator species.

3.1.3 Alternative 3 – WS-Wyoming Provides Technical Assistance Only

Direct Impacts: Under this alternative, WS-Wyoming would only provide advice or guidance on PDM techniques and methods. WS-Wyoming would not conduct any direct operational PDM in attempting to resolve damage complaints. Therefore, WS-Wyoming would have no direct impacts on predator populations in Wyoming. Whereas predator take by WS-Wyoming would be substantially lower (zero) under this Alternative, the direct impacts of WS-Wyoming 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-Wyoming 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, Howard Jr. and Shaw 1978, Nass 1980, Howard Jr. 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 (WDA and WGFD), PMDs, 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 PMDs 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-Wyoming, (2) those who would no longer request assistance from WS-Wyoming, and (3) those who do not currently request assistance from WS-Wyoming.

In the first scenario, WS-Wyoming 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-Wyoming, 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 PMDs. 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-Wyoming 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-Wyoming 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-Wyoming 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 lower. This incorporates the reasons for lower PDM take discussed under Alternative 2. PDM take would likely be lower for red foxes, and lower for raccoons and striped skunks. 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 by WS-Wyoming.

The cumulative harvest of these target predator species under Alternative 3 would likely be negligibly lower (<1%) for all species. Because WGFD intensively manages black bears and mountain lions, cumulative take for these species would be virtually identical to that under Alternative 1; WGFD would continue to manage these species for cumulative take, according to their target objectives.

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-Wyoming

Direct Impacts: Under this alternative, WS-Wyoming would not provide assistance with PDM, so there would be no direct impact by WS-Wyoming on target predator populations in Wyoming. The take of these predator species by WS-Wyoming 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-Wyoming 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, Howard Jr. and Shaw 1978, Nass 1980, Howard Jr. and Booth 1981, O'Gara et al. 1983, Wagner and Conover 1999), and state agencies (WDA and WGFD), private entities, and PMDs 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-Wyoming 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. The lack of non-lethal technical assistance from WS-Wyoming 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 Wyoming under Alternative 4 would be the same as that for Alternatives 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-Wyoming, 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-Wyoming PDM Program

During FY14-18, WS-Wyoming took 27 different non-target species during PDM, averaging 18 animals killed per year and 23 animals freed (Table 3-16). Of the 228 total non-target animals WS-Wyoming took during FY14-18, only 101 of them (0.2% of total predator take) were taken lethally (average of 18 animals taken lethally per year). The other 127 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 (12 of 27 species, and 130 of 228 animals) were other mammalian predator species which were not targeted during a specific operation. 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-Wyoming take analyzed for each target species. Nonlethal take of these target species would not affect the species' populations. The potential impact 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 FY14-18 included one beaver *(Castor canadensis),* 49 mule deer*(Odocoileus hemionus),* nine white-tailed deer *(Odocoileus virginianus),* 12 pets or livestock, seven swift foxes *(Vulpes velox),* one deer mouse*(Peromyscus maniculatus),* seven pronghorn antelope *(Antilocapra americana),* four feral sheep *(Ovis spp*.), one red squirrel*(Tamiasciurus hudsonicus*), two gray wolves *(Canis lupus),* one brown-headed cowbird *(Molothrus ater*), one golden eagle *(Aquila chrysaetos),* one greater sage-grouse *(Centrocercus urophasianus),* one common raven *(Corvus corax),* and one wild turkey *(Meleagris gallopavo).* The red squirrel, the gray wolves, the brown-headed cowbird, the wild turkey, 18 mule deer, two white-tailed deer, 11 pets or livestock, one swift fox, three pronghorn, and three feral sheep were released alive and unharmed. Pets and livestock are discussed under Public Safety and Pets. The golden eagle is discussed in section 3.2.1.2.

Beavers are found throughout a majority of Wyoming (Buskirk 2016). This species is managed as a furbearer by WGFD with established trapping seasons. Additionally, Wyoming Statute 23-3-114 allows any landowner, lessee of state lands or employee of the landowner or lessee or an agent of the landowner or lessee to take any beaver flooding meadows, damming irrigation systems or constructing dams or ponds which would be dangerous to livestock on any privately owned lands or on state lands. WS conducts beaver damage management under a WGFD permit, and reports on target and non-target take annually.

Worldwide, beaver populations are listed as stable and the beaver is classified as a species of "least concern" according to the IUCN (Cassola 2016a). In addition, when considering the estimated take of beaver statewide during 2018 was 1,582, we are confident that local effects from the removal of one non-target beaver for wildlife damage management by WS-Wyoming (1 beaver total during FY2014-2018) would result in no adverse effects.

Table 3-16. All nontarget animals taken by WS-WY during PDM from FY14 through FY18 on all land classes in Wyoming.

		Total FY14-FY18		Average FY14-FY18	
Group	**Species**	**Killed**	**Freed**	**Killed**	**Freed**
Target Mammalian Predators	Badger	7	0	1	0
	Black Bear	0	1	0	0
	Bobcat	8	17	2	3
	Feral Cat	0	55	0	11
	Feral Dog	0	6	0	1
	Red Fox	10	1	2	0
	White-tailed Jackrabbit	9	1	2	0
	Mountain Lion	1	2	0	0
	Virginia Opossum	0	1	0	0
	Porcupine	5	0	1	0
	Raccoon	4	0	1	0
	Striped Skunk	2	0	0	0
Other Mammals	Beaver	1	0	0	0
	Mule Deer	31	18	6	4
	White-tailed Deer	7	2	1	0
	Pet or Guard Dogs	1	11	0	2
	Swift Fox	6	1	1	0
	Deer Mice	1	0	0	0
	Pronghorn	4	3	1	1
	Feral Sheep	1	3	0	1
	Red Squirrel	0	1	0	0
	Gray Wolf	0	2[b]	0	0
Birds	Brown-Headed Cowbird	0	1	0	0
	Golden Eagle	1	0	0	0
	Greater Sage-Grouse	1	0	0	0
	Common Raven	1	0	0	0
	Wild Turkey	0	1	0	0
All	**Total[a]**	**101**	**127**	**18**	**23**

[a]Totals may not exactly match the numbers due to rounding.
[b]Collared and released

Mule deer are found throughout Wyoming (Buskirk 2016) and are managed as big game animals by WGFD, with established hunting seasons. Wyoming hunters harvested an annual average of 27,782 during FY14-18 (Wyoming Game and Fish Department 2018b). The average lethal non-target take of 6 mule deer a year by WS-Wyoming is approximately 0.02% of the estimated annual hunter harvest. This level of take is negligible compared to hunter harvest and will have no impact on the mule deer population. The average non-lethal non-target annual take of 4 mule deer had no impact on the statewide population. Range wide, mule deer are listed as having a stable population and are classified as a species of “least concern by the IUCN (Sanchez Rojas and Gallina Tessaro 2016).

White-tailed deer are widely distributed across Wyoming in suitable habitats (Buskirk 2016). They are managed as big game animals by WGFD with open seasons for harvest. Wyoming hunters harvested an annual average of 17,040 white-tailed deer during FY14-18 (Wyoming Game and Fish Department 2018b). The average annual lethal take by WS-Wyoming during FY14-18 was one non-target white-tailed deer. This is approximately 0.005% of the average annual hunter harvest. In total, WS-Wyoming took seven non-target white-tailed deer lethally during this time frame.

WS-Wyoming also captured 2 non-target white-tailed deer, which were freed unharmed. This level of non-target take by WS-Wyoming in light of hunter harvest numbers is negligible and will have no impact on the state white-tailed deer population. Range wide, white-tailed deer populations are considered stable and they are classified as a species of “least concern” by the IUCN (Gallina and Lopez Arevalo 2016).

Swift foxes occupy the eastern half of Wyoming (Buskirk 2016); however, reports of swift foxes have been documented across the state. Swift foxes are managed by WGFD and are classified as a protected non-game mammal. There is no open harvest season for swift foxes in Wyoming, but Chapter 52 nongame wildlife regulations allow for incidental take. Estimates of swift fox abundance in Wyoming are not available, but the species is considered to be widely distributed across suitable habitat and may be locally abundant (Wyoming Game and Fish Department). Historically, swift fox populations were in a moderate decline, but recently they are considered to be stable to increasing (Wyoming Game and Fish Department). Populations of swift foxes in Wyoming are secure enough that WGFD allowed 56 swift foxes to be translocated to South Dakota between 2005 and 2006 (Turner Endangered Species Fund 2008). During FY14-18, WS-Wyoming lethally took six non-target swift foxes and was able to release one non-target swift fox unharmed. Given that swift fox populations in Wyoming are robust enough to allow for translocations to other states, and WGFD regulations allow for incidental take, WS-Wyoming's average annual lethal take of one swift fox will have no impact on the swift fox population. Range wide, swift fox populations are reported to be stable and the swift fox is classified as a species of “least concern” by the IUCN (Moehrenschlager and Sovada 2016).

Deer mice are one of the most abundant and widespread mammals in Wyoming and are not considered to be a conservation concern (Buskirk 2016). Deer mice are classified as nongame animals in Wyoming and their management falls under the purview of WGFD. Chapter 52 nongame regulations, section 9, subsection b allows for the take of deer mice in accordance with the provisions of Wyoming Statute 11-5-101 through Wyoming Statute 11-5-119. According to the IUCN, deer mice are a species of “least concern” and their population trend is stable (Cassola 2016b). WS-Wyoming's take of one non-target deer mouse will have no impact on the statewide population.

Pronghorn are common or abundant in Wyoming throughout their geographic range (Buskirk 2016). Pronghorn are classified as big game animals and are managed by WGFD. In FY 14-18, Wyoming hunters harvested an annual average of 39,822 pronghorn (Wyoming Game and Fish Department 2018a). During this same time period, WS-Wyoming took four non-target pronghorn lethally, and were able to release three non-target pronghorn unharmed. This equates to an annual average of one lethally taken non-target pronghorn and one non-lethal non-target pronghorn take. One lethally taken non-target pronghorn is equal to approximately 0.003% of the annual average hunter harvest in FY14-18. WS-Wyoming non-target take of pronghorn is negligible in comparison to this number and is having no impact on the Wyoming antelope population. According to the IUCN, the pronghorn population trend is stable and they are classified as a species of “least concern” (IUCN SSC Antelope Specialist Group 2016).

In FY14-18 WS-Wyoming lethally took one non-target feral sheep and was able to free unharmed 3 non-target feral sheep. This equates to an annual average of 1 non-target feral sheep released unharmed by WS-Wyoming over the five-year time period. Non-target take of feral or free-ranging sheep by WS-Wyoming is considered to have no deleterious impact on the human environment because feral sheep are not an indigenous component of the ecosystem. Therefore, no further analysis of population impacts is provided.

One non-target red squirrel was taken by WS-Wyoming in FY14-18. This individual was released unharmed. Red squirrels are common or abundant in suitable habitats in Wyoming (Buskirk 2016). Red squirrels are managed as small game animals by WGFD with established hunting seasons. The IUCN reports the red squirrel population trend as stable and it is classified as a species of "least concern" (Cassola 2016c). WS-Wyoming non-target take of one red squirrel during a five-year time period will have no impact on red squirrel populations, especially since the take was non-lethal.

In 2018, for the 17th consecutive year, the Wyoming gray wolf population remained above the minimum delisting criteria established by the USFWS. At the end of 2018 there were at least 286 wolves in Wyoming (Wyoming Game and Fish Department et al. 2019). In Wyoming, wolves have a split status classification. In the Wolf Trophy Game Management Area, wolves are managed as a trophy game species by WGFD. This area lies in the northwestern corner of the state. In all other portions of the state, wolves are classified as predatory animals and management authority rests with WDA. In the Wolf Trophy Game Management area, WGFD sets harvest regulations and quotas. In all other portions of the state, wolves may be taken at any time by any legal method. In FY14-18, WS-Wyoming captured two non-target wolves and was able to release them unharmed. WS-Wyoming was able to collar these individuals under a Chapter 33 permit from WGFD, which provides data to WGFD on wolf movements that might otherwise remain unknown, a priority in the Wolf Trophy Game Management Area. Given that both incidents of non-target wolf take by WS-Wyoming were non-lethal, they had no impact on the Wyoming wolf population. A comprehensive review of WS-Wyoming wolf damage management activities can be found in the Environmental Assessment *Gray Wolf Damage and Conflict Management in Wyoming* (USDA Wildlife Services 2019a). The IUCN reports that the global gray wolf population trend is stable and gray wolves are classified as a species of "least concern" (Boitani et al. 2018).

Brown-headed cowbirds are common summer resident of Wyoming and have been documented as breeding throughout a majority of the state (Orabona et al. 2016). Breeding Bird Survey data suggest the long-term trend for brown-headed cowbirds between 1966 and 2015 has been stable, with a 0.5% increase in the population. In FY14-18, WS-Wyoming took one non-target brown-headed cowbird, which was able to be released unharmed. Despite no targeted take during this 5-year time period, brown-headed cowbirds are a species that can be targeted by WS-Wyoming. This analysis is covered in the Environmental Assessment *Bird Damage Management in Wyoming* (WS 2008). The non-lethal non-target take of one brown-headed cowbird in a five-year period will not have an impact on brown-headed cowbird populations.

Greater sage-grouse are a native species in Wyoming and have been documented throughout the state (Orabona et al. 2016). They are managed by WGFD as a game bird and regulated hunting seasons exist in some portions of the state. In FY14-18, Wyoming hunters averaged an annual harvest of 9,279 sage grouse (Wyoming Game and Fish Department 2019). The one non-target take of a greater sage-grouse by WS-Wyoming in the period of FY14-18 is equal to approximately 0.01% of the annual hunter harvest. This level of non-target take is negligible compared to hunter harvest and results in no impact to greater sage-grouse populations.

Common ravens are abundant throughout much of Wyoming, and their populations have increased significantly over the last 40 years (Manzer and Hannon 2005, Coates and Delehanty 2010, Coates et al.

2016). As a predatory bird species, they occasionally cause damage to agricultural and natural resources, and as such, they are targeted by WS-Wyoming and non-federal entities for lethal control. During FY14-18, WS-Wyoming lethally targeted 6,864 common ravens. The common raven is addressed under a separate EA (USDA Wildlife Services 2008). Their worldwide population trend is increasing, and they are listed as a species of "least concern" according to the IUCN (BirdLife International 2017). The non-target take of one common raven over five years is negligible compared to their abundance and the number that are targeted annually.

Wild turkeys are common throughout the eastern third of Wyoming and parts of north central and northwestern Wyoming in suitable habitats (Orabona et al. 2016). Wild turkeys are managed by WGFD as a game bird species and regulated hunting seasons exist. In FY14-18, Wyoming hunters harvested an annual average of 3,495 wild turkeys (Wyoming Game and Fish Department 2019). In this same time period WS-Wyoming had one non-lethal non-target take. This level of non-target take will have no impact on wild turkey populations, especially given the turkey was released unharmed.

3.2.1.1 Effects on Listed Threatened and Endangered Species

WS-Wyoming has consulted with the USFWS on potential impacts of PDM activities on federal listed threatened and endangered species, including critical habitat (Biological Assessments dated September 28, 2007, November 21, 2014, and November 15, 2015)(USDA Wildlife Services 2007;2014a;2015b). The USFWS concurred with WS-Wyoming's analysis and mitigation measures to avoid impacting threatened and endangered species (Biological Opinions dated September 28, 2007 and March, 10, 2015; Concurrence letter dated February 6, 2015)(U.S. Fish and Wildlife Service 2007b;2015b;a).

WS-Wyoming has also played important roles in assisting with the recovery of federally listed threatened and endangered wildlife in Wyoming (i.e. black-footed ferret).

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 federally listed species occurring in Wyoming, PDM has the potential to adversely affect certain terrestrial vertebrate species (mammals), as discussed below. Three T&E species could be adversely affected by PDM activities, whereas two T&E species could benefit.

WS-Wyoming PDM will have no effect on any of Wyoming'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. The list of fish and amphibian T&E species in Wyoming includes the Wyoming toad, bonytail, Colorado pikeminnow, humpback chub, Kendall Warm Springs dace, pallid sturgeon, and razorback sucker.

Wyoming does not have any listed reptile species. WS-Wyoming PDM will have no effect on any of Wyoming's T&E plant species because PDM activities do not modify or impact habitat to any extent, and PDM activities are not generally conducted in the habitats of such species. Moreover, WS-Wyoming follows protective measures (as discussed in Chapter 2) to minimize or eliminate any potential impact to these species. Such protective measures cover the following plant species: blowout penstemon, desert yellowhead, Ute Ladies'-tresses, and western prairie fringed orchid WS-Wyoming PDM will also have no effect on either the western glacier stonefly or the whitebark pine (no-effect memos on file). Potentially affected bird species are least tern, piping plover, whooping crane, and yellow-billed cuckoo. The following mammal species also fit into this category: northern long-eared bat and Preble's meadow jumping mouse. WS-Wyoming PDM will have no impact on black-footed ferrets or could have a positive impact. Information on federal listed threatened and endangered species is presented in Table 3-17. USFWS and WGFD monitor several species considered threatened or endangered in Wyoming to determine if different activities singly or in combination are impacting their 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 construction, 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 definitively even with unlimited funding: they can only be estimated based on population trend monitoring (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-Wyoming consults with WGFD and USFWS, as necessary, to provide them with information regarding WS-Wyoming's potential to take these species using existing PDM methods. WS-Wyoming has determined that one or more PDM activities has/have the potential to adversely affect three T&E species.

Table 3-17. Federal threatened and endangered species in Wyoming, and the potential for WS-Wyoming PDM activities to impact these species.

Group	Common Name	Scientific Name	Status	Location in Wyoming	Habitat	PDM Impacts
Mammals	Black-Footed Ferret	*Mustela nigripes*	Nonessential Experimental	Park, Carbon, Albany Counties	Grassland	None or Positive
	Canada Lynx	*Lynx canadensis*	Threatened	Northwest, North and South-Central Mountains	Forests	Negative, None, Positive
	Grizzly Bear	*Ursus arctos horribilis*	Threatened	Northwest	Various	Negative, None
	North American Wolverine	*Gulo gulo luscus*	Proposed Threatened	Northwest, North Central Mountains	Various	Negative, None
	Northern Long-Eared Bat	*Myotis septentrionalis*	Threatened	Northeast	Forests	None
	Preble's Meadow Jumping Mouse	*Zapus hudsonius preblei*	Threatened	Southeast	Wetland	None
Birds	Least Tern	*Sterna antillarum*	Endangered	Historically Present	Sandbars	None
	Piping Plover	*Charadrius melodus*	Threatened	North Platte River Watershed	Sandbars, Mudflats, Lakes	None
	Whooping Crane	*Grus americana*	Endangered	Could Occur in East, Historically Present	Wetland	None
	Yellow-Billed Cuckoo	*Coccyzus americanus*	Threatened	Southwest	Forests	None
Amphibians	Wyoming Toad	*Bufo hemiophrys baxteri*	Endangered	Albany County	Wetlands	None
Fish	Bonytail	*Gila elegans*	Endangered	Historically Present	Rivers	None
	Colorado Pikeminnow	*Ptychocheilus lucius*	Endangered	Southwest	Rivers	None
	Humpback Chub	*Gila cypha*	Endangered	Southwest	Rivers	None
	Kendall Warm Springs Dace	*Rhinichthysosculus thermalis*	Endangered	Sublette, Teton Counties	Springs, Creeks	None
	Pallid Sturgeon	*Scaphirhynchus albus*	Endangered	Historically Present	Rivers	None
	Razorback Sucker	*Xyrauchen texanus*	Endangered	Historically Present	Rivers	None
Insects	Western Glacier Stonefly	*Zapada glacier*	Threatened	Northwest	Alpine Meltwater	None

Group	Common Name	Scientific Name	Status	Location in Wyoming	Habitat	PDM Impacts
Flowering Plants	Blowout Penstemon	*Penstemon haydenii*	Endangered	Carbon, Goshen Counties	Range	None
	Desert Yellowhead	*Yermo xanthocephalus*	Threatened	Fremont Count	Range	None
	Ute Ladies'-tresses	*Spiranthes diluvialis*	Threatened	Throughout state, with exception of mountains	Range, Wetlands	None
	Western Prairie Fringed Orchid	*Platanthera praeclara*	Threatened	North Platte River Watershed	Grasslands, Wetlands	None
Conifers and Cycads	**Whitebark Pine**	*Pinus albicaulis*	Candidate	Northwest	Forests	None

Canada Lynx

The majority of WS-Wyoming PDM actions occur below 7,000 feet in open grazing areas, mountain valleys, prairies, high desert and sagebrush habitats that are not generally preferred by Canada lynx, although dispersing lynx may move through these areas. There have been no instances of unintentional capture, injury or death of a Canada lynx in the last 30 years of the WS-Wyoming program. Should a lynx be unintentionally captured or killed, WS-Wyoming would report such an incident to the WGFD nongame program. Conservation measures and terms and conditions used by WS-Wyoming to reduce risks to lynx in addition to WS-Wyoming protective measures include:

- All WS personnel will be trained in the identification of Canada lynx and lynx sign. Recent maps of lynx locations obtained from the USFWS will be used in training;
- All sightings of Canada lynx will be reported to the USFWS as soon as possible;
- Coordinate wildlife damage management activities on U.S. Forest Service lands and Bureau of Land Management lands during work plan meetings to share information about lynx observations or issues that may affect WS activities.
- If lynx or lynx sign are observed, restrict coyote and bobcat control actions in the area and contact the Service within one working day of observation, or as soon as possible thereafter to discuss additional management options. Restrictions are as follows:
- Disallow use of fish oil and anise oil attractants, fresh meat and visual attractants of the type that entice felids in coyote sets where lynx or lynx sign are observed. Visual attractants are of the type expected to attract lynx such as feathers, shiny metal objects or suspended bright fabric subject to move in the wind.
- Disallow use of M-44s where lynx or lynx sign are observed.
- Restrict wildlife damage management actions in suitable lynx habitat. Suitable lynx habitat in Wyoming is identified as subalpine forests dominated by subalpine fir and Engelmann spruce, and the upper montane forests of mesic lodgepole pine, including mixed stands of pine, aspen and spruce. In Wyoming, the subalpine and upper montane forest zones, are typically 8,000 to 12,000 feet in elevation. Vegetation communities such as high elevation sagebrush and riparian and wetland shrub habitats, adjacent to subalpine and upper montane forest communities, also provide suitable lynx habitat. Dry forests, such as ponderosa pine and climax lodgepole pine are not suitable lynx habitat (Ruediger et al. 2000). These restrictions are as follows:

- Disallow use of fish oil and anise oil attractants, fresh meat and visual attractants of the type that entice felids in coyote sets within suitable lynx habitat.
- Disallow use of M-44s in suitable lynx habitat.
- Only use foot-hold traps and foot snares for mountain lions, bears, and wolves that are equipped with pan tension devices set to trip at weights that will preclude capture of lighter-weight lynx.
- Positively identify the species of a target animal, prior to implementing any lethal management action involving shooting or aerial shooting and actions conducted at den sites.
- When using neck snares to capture mountain lions and bears ensure that the cable loop is large enough to preclude capture of lynx (12 inches or greater).
- M-44 sets will not be baited with fish oil or anise oil attractants, fresh meat or visual attractants statewide.
- Immediately call tracking dogs off lynx trails and harness them.
- Immediately release any lynx incidentally trapped, captured or inadvertently treed, and notify the Service as soon as possible. If a lynx has been injured and cannot be rehabilitated or safely released, it may be euthanized by WS at the capture site. Any such euthanasia will be considered a take under the incidental take statement. WS will use humane measures to euthanize any injured lynx and will contact the Service as soon as possible regarding the incident.

Based on the above information and information presented in the WS Biological Assessment, the USFWS Biological Opinion concluded that the proposed action would not result in the take (defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct) of more than 2 Canada lynx and that this level of take would not jeopardize the Canada lynx population (U.S. Fish and Wildlife Service 2007b).

Grizzly Bear

Through consultation with the USFWS, WS-Wyoming determined that the grizzly bear might potentially be affected by WS-Wyoming PDM activities. The USFWS has concurred that WS-Wyoming PDM methods are not likely to jeopardize grizzly bears in Wyoming (U.S. Fish and Wildlife Service 2015b).

The USFWS determination regarding grizzly bears was based, in part, on the following considerations:

- Under current management policy, WS-Wyoming does not utilize neck snares set for mountain lions or black bears, with or without stops, within occupied grizzly bear habitat between March 1 and December 1 unless specifically authorized.
- WS-Wyoming will implement several conservation measures that will reduce the likelihood of adversely affecting grizzly bears (U.S. Fish and Wildlife Service 2015b). These measures include:
    - WS-Wyoming will assist the USFWS and WGFD with grizzly bear recovery by maintaining interagency coordination and communication, reporting grizzly bear sightings, assisting with grizzly bear damage management, and assisting with research projects related to grizzly bear conservation and recovery;
    - WS-Wyoming personnel will be trained in the identification of grizzly bears (particularly in distinguishing between black bears and grizzly bears) and grizzly bear sign, training will be conducted by WS-Wyoming, in collaboration with the local USFWS or WGFD

offices and by attending annual bear handling workshops organized by the USFWS and WGFD; and

- WS-Wyoming personnel will carefully consider the possibility of the presence of grizzly bears before conducting any predator damage management activities within or adjacent to occupied grizzly bear habitat and if there are foreseeable conflicts with grizzly bears, WS will adjust their operations accordingly to minimize the chances of adversely affecting grizzly bears.
- If grizzly bear sign occurs in the area WS-Wyoming will attempt to set predator traps away from livestock carcasses to reduce the likelihood of capturing a grizzly bear; if grizzly bears are in the area, WS-Wyoming would utilize scents at trap sites that are less attractive to grizzly bears, such as wolf urine/scat and wolf traps would be staked solidly with an appropriate drag attached to the trap.

Based on the above information and a review of the last 10 years of take data, the USFWS predicted that 5 grizzly bears might be unintentionally captured by WS-Wyoming (all WS-Wyoming damage management actions combined, including PDM). Of the 5 captures, no more than 2 are expected to result in the death of the bear. The USFWS has determined that this level of mortality will not result in jeopardy to the grizzly bear population (U.S. Fish and Wildlife Service 2015b). WS-Wyoming has had no non-target grizzly bear take since the release of the USFWS biological opinion. Additionally, all WS-Wyoming grizzly bear targeted take is at the direction of WGFD, which consults with the USFWS. For further analysis on WS-Wyoming grizzly bear take, see Section 3.1.1.16.

North American Wolverine

WS-Wyoming may conduct PDM in areas where the Protected Species under Wyoming statute, North American wolverine (*Gulo gulo luscus*) may be present. USFWS issued a proposed rule for wolverines in 2016; however, on October 9, 2020, USFWS withdrew its proposal to list the wolverine (*Gulo gulo*) under the federal ESA stating that factors affecting populations are not as significant as believed and that the American Northwest population remain stable. Because wolverines are a Protected Species in Wyoming, WS-Wyoming protective measures for wolverines, which would have been consistent with the USFWS proposal, will remain in place. While methods used by WS-Wyoming are capable of capturing a wolverine, there is little risk of that occurring under the proposed actions based on the locations where WS-Wyoming generally conducts PDM and the protective measures implemented by WS-Wyoming.

The majority of wolverine habitat falls outside of areas where WS-Wyoming typically conducts PDM. The majority of WS-Wyoming PDM activities occur on private property below 7,000 feet elevation in open livestock grazing areas, mountain valleys, open prairies, high desert, or sagebrush habitats. (Inman et al. 2012) reported that wolverines in the GYE avoided areas less than 7,000 feet in elevation, and that natal dens occurred between 7,218 and 9,259 feet (Inman et al. 2007).

Nationwide, over the last 20 years there have been only 5 instances of unintentional take of wolverines by APHIS-WS in wildlife damage management equipment similar to that proposed for this EA. In all but one instance, the wolverine was able to be released onsite. Wyoming regulations require that foothold traps be checked once every 72 hours, which increases the probability that an unintentionally captured wolverine could be released from a trap unharmed. Nonetheless, WS-Wyoming has implemented the following protective measures in occupied wolverine habitat above 7,000 feet to prevent unintentional take:

- In areas of Wyoming on National Forest lands where wolverines may occur, foothold traps set by WS-Wyoming for capturing wolves, coyotes, and mountain lions and foot snares set for black bears, grizzly bears, or mountain lions will be placed away from animal carcasses and musky or castor-based olfactory lures will not be used unless the use of such lures is absolutely necessary. Additionally, a detailed site assessment will be performed by WS-Wyoming personnel to ensure no fresh wolverine sign is present. If sign or other information (e.g., reports from USFS) indicates wolverines are actively using the project area, foothold traps will not be used.

- Neck snares set for capturing black bears, wolves, coyotes, and mountain lions in occupied wolverine habitat will be placed away from animal carcasses, will not use musky or castor-based lures and WS-Wyoming will perform a detailed site assessment to ensure no fresh wolverine sign is present.

WS-Wyoming has not taken any wolverines during any wildlife damage management activities in the last 20 years. Should a wolverine be unintentionally captured or killed during WDM activities, WS-Wyoming will report the incident to the WGFD. WS-Wyoming has also determined that the proposed action is not likely to have any adverse effects on the wolverine population and does not warrant consultation under Section 7 of the ESA. Should wolverines become listed, WS-Wyoming will initiate consultation under Section 7 with the USFWS, as appropriate.

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-Wyoming with lead ammunition. USDA, APHIS, Wildlife Services has carefully considered the potential for negative effects from lead ammunition use (USDA Wildlife Services 2017c)
Much of the risk of lead consumption in eagles appears to be associated with eagles foraging on offal piles or waterfowl which have ingested lead ammunition or fishing tackle (Domenich and Langler 2009, 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 seasons. 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-Wyoming 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-Wyoming are taken via use of shotguns from aircraft.

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). (USDA Wildlife Services 2017c)

In Colorado, 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. These factors combined with the usual behavior of regurgitation of ingested lead shot suggest a low potential for toxic absorption of lead from eagles feeding on coyotes killed by aerial PDM. In fact, of known causes of anthropogenic mortality of golden eagles with satellite transmitters, lead toxicity was the least common form of eagle mortality (U.S. Fish and Wildlife Service 2016). Eagle mortality from WS-Wyoming's use of lead ammunition is possible, although no known instances directly attributable to WS-Wyoming 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. 2017). 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-Wyoming'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-Wyoming's personnel under the proposed action alternative (Alternative 1) could occur in areas where Bald Eagles are present. However, WS-Wyoming 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*" (U.S. Fish and Wildlife Service 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-Wyoming would not conduct activities that were located near known eagle nests and would follow the National Bald Eagle Management Guidelines (U.S. Fish and Wildlife Service 2007a) 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 (U.S. Fish and Wildlife Service 2007a).

Two specific PDM methods which could potentially adversely affect bald eagles and golden eagles is the use of foothold traps and snares. 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-Wyoming has not taken a non-target bald eagle. In FY14-18 WS-Wyoming had one non-target golden eagle take. WS-Wyoming will minimize the future risks of non-target eagle take by abiding by the WS-Wyoming implemented protective measures, as provided in Section 2.11.

According to the IUCN, bald eagles typify an increasing population trend, and golden eagle populations are stable throughout their respective ranges. Both species are classified as species of "least concern" (BirdLife International 2016;2019). The population trends of bald and golden eagles indicate that mortality from all causes has not exceeded the sustainable threshold.

Under Alternative 1, we do not anticipate any significant difference in our potential to impact eagles; thus, we expect negligible direct and no indirect or cumulative impacts to eagle populations from WS-Wyoming PDM.

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-Wyoming. 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 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 (Eisler 1991;1998b;a, Beyer et al. 2004, U.S. Environmental Protection Agency 2005, Clausen and Korte 2009). 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; however, the potential for lead poisoning is low for some bird species (Keel et al. 2002). 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 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-Wyoming does not use lead ammunition in areas where it is prohibited by law or where prohibited by the landowner/manager. 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). Please see the WS lead use risk assessment (USDA Wildlife Services 2017c).

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 substrates, and for WS-Wyoming personnel in aerial PDM teams. Ammunition which delivers its full energy to the target animal and which results in low or no pass through is essential for reasons of humaneness (instant or near-instant incapacitation) and to reduce safety risks associated with wounded animals.

One of the biggest challenges associated with lead-free ammunition is that some types are harder than lead ammunition and consequently, are 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. 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 (what happens to 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-Wyoming.

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, which may be considered less humane. WS-Wyoming 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 where it is legal to use lead ammunition.

WS-Wyoming strives to use the fewest number of shots on targeted animals. Lead ammunition use by WS-Wyoming for PDM activities is minimal compared to lead use at firing ranges and for hunting activities, fishing, and shooting sports. The national WS program's 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-Wyoming 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. 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 increasing in the state, in the Western BBS region and nationwide (Sauer et al. 2017). Impacts of lead ammunition on eagle populations were discussed above (Section 3.2.1.2). 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 APHIS-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-Wyoming use of lead ammunition would be very low. Given that the majority of lead ammunition is used by non-WS-

Wyoming 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 to the environment. If state or federal law or WS-Wyoming policy were changed to require an adherence to more restrictive use of lead ammunition, WS-Wyoming 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 populations of non-target 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. United States National Park Service (1995) reviewed many such studies and discovered that a number of them have documented responses by certain wildlife species that suggest adverse impacts could occur. Few, if any, such studies have documented significant adverse impacts to 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 pertaining to this issue (Air National Guard 1997).

WS-Wyoming aerial PDM activities are infrequent on specific parcels of lands and typically of short duration. During FY14-18, WS-Wyoming conducted aerial PDM on agreements which comprised 45,748 mi^2, which is approximately 47% of the 97,798 mi^2 in the State of Wyoming. WS-Wyoming PDM, including aerial PDM, is typically only conducted on a small proportion of any property under agreement. WS in New Mexico (USDA Wildlife Services 1997c) 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 (USDA Wildlife Services 1997c). 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 Wyoming: WS-Wyoming actually conducts PDM, including aerial PDM, on approximately 1/5 of lands under agreement. Using this calculation, less than 10% of the land area of Wyoming was exposed to WS-Wyoming aerial PDM in a typical year. WS aerial PDM only occurs on a fraction of the land area in the state, and therefore only has limited potential to impact non-target species.

WS-Wyoming 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 FY14-18, WS-Wyoming flew an average of 2,506 hours per year for aerial PDM, which includes all properties flown.

WS-Wyoming 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-Wyoming is expected to spend less than 4,000 hours conducting aerial PDM, covering less than 10% of the lands in Wyoming in any typical year, based on the analyses above.

Water birds 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 water birds 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 wigeons (*A. americana*), gadwalls (*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 water birds 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, Air National Guard (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, U.S. Forest Service 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, Air National Guard 1997). There is considerable evidence that eagles would not be adversely affected by WS-Wyoming 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-Wyoming aerial PDM flights have little or no potential to adversely affect raptors.

Passerines: 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-Wyoming 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, U.S. Forest Service 1992). These studies and reviews indicate there is little or no potential for WS-Wyoming overflights to cause adverse effects on passerine bird species.

Sage-grouse: 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 (U.S. Fish and Wildlife Service 2010). Because WS-Wyoming 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 of overflights to sage-grouse is that WS-Wyoming aerial crews can watch for and report any new lek locations to the WGFD or other appropriate land management agencies; these entities can then take any necessary actions to protect such sites from other potentially more chronic sources of disturbance, as appropriate. Because WS-Wyoming aerial PDM crews watch for and avoid leks during the breeding season, no adverse effects on sage-grouse are expected. PDM activities that remove coyotes and red foxes (the species usually targeted by WS-Wyoming aerial PDM activities) may actually benefit sage-grouse and other prairie grouse species by reducing predation by these species.

Deer: Krausman et al. (1986) reported that fixed-wing overflights by Cessna 172 and 182 model small aircraft ≥ 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 airplanes used for most WS-Wyoming 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-Wyoming 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 deer to the point that heavy winter kill losses are likely. However, the potential for adverse effects on wintering deer, particularly during severe winter conditions, is minimized by the fact that WS-Wyoming's aerial PDM pilots are instructed to avoid concentrations of deer and other readily visible non-target wildlife.

Also, removal of coyotes during winter may benefit wintering mule deer herds to some extent. Coyotes are documented to be responsible for 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) found that coyote removal increased fawn survival under certain conditions. Coyotes may cause additional, indirect stress on wintering deer from 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). 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 individuals to survive through severe winters.

Since the 1970's, mule deer populations in Wyoming have been in decline. In 1991, about 578,000 mule deer inhabited the state; by comparison, in 2016 the mule deer population had declined 31% to an estimated 396,000 animals. In 2007, the WGFC responded to this problem by adopting the Wyoming Mule Deer Initiative (WMDI) with the intent to identify the most pressing issues affecting Wyoming's mule deer and develop individual management plans for key populations (Mule Deer Working Group 2018). The WMDI evaluates a number of variables that have influenced the decline of mule deer in Wyoming, including: altered fire intervals, invasive plants, fragmented habitat, climatic extremes, competition with other wildlife species, predation, hunting frameworks, disease, and increased use of All Terrain Vehicles.

Whereas deer numbers in Wyoming have been on the decline, we find no evidence that this is due in any part to aerial PDM. 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. WS-Wyoming'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-Wyoming aerial PDM overflights on deer winter range cause any substantive adverse impacts on deer populations.

We conclude that WS-Wyoming aerial PDM operations produce minimal disturbance to deer, and consequently, will have no impact on their populations. In fact, it is probable that aerial PDM provides a 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. On a statewide basis, elk populations have remained stable over the last ten years, all during which WS-Wyoming aerial activities have been occurring. The Statewide population has increased from about 95,000 in 2007 to 104,800 in 2017 (Wyoming Game and Fish Department 2008). 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, the response of bighorn sheep 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. 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-Wyoming rarely conducts aerial PDM in areas occupied by wild bison herds in Wyoming, 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 pronghorns 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. 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.

Wild Horses: Sixteen wild horse areas (Herd Management Areas) are located on BLM lands and other land classes in Wyoming (Adobe Town, Antelope Hills, Conant Creek, Crooks Mountain, Dishpan Butte, Divide Basin, Fifteenmile, Green Mountain, Little Colorado, Lost Creek, Mccullough Peaks, Muskrat Basin, Rock Creek Mountain, Salt Wells Creek, Stewart Creek, and White Mountain) (Bureau of Land Management 2011). Concern is sometimes expressed that aircraft overflights could impact horses. We could not find any studies conducted specifically to quantify wild horse responses 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 roundups. 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 fixed-wing aircraft, even to the point of not getting up from a recumbent position. We conclude that WS-Wyoming'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 Rehart 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 (Air National Guard 1997). Small mammals habituate, albeit with difficulty, to sound levels greater than 100 dBA (A-weighted decibels) (U.S. Forest Service 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 10% of the land area of the State during an average year [1/5 of the 47% of acres in agreements which were flown, using the calculations of (USDA Wildlife Services 1997b)]; this indicates that more than 90% of small mammal populations are not exposed to WS-Wyoming aerial PDM overflights. Additionally, 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. While livestock managers can and do express concern for such disturbances, they are the ones requesting PDM assistance in most cases and are more concerned with stopping or preventing predation on their livestock. Furthermore, WS policy requires pilots to stay at least 500 feet from livestock during aerial PDM activities. 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-Wyoming 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 FY14-18, WS-Wyoming used helicopters for an annual average of 78.9 hours for aerial PDM. Under alternative 1, helicopters would continue to be used for aerial PDM. 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 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 (Air National Guard 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 Air National Guard (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 higher noise levels and are flown over certain training areas as many as 2,500 times per year. Further lessening the potential effect from WS aerial PDM flights is that these flights occur on a relatively small proportion of the land area of the State and a small proportion of public lands. See section 3.5.1.3 for a more complete analysis of WS-Wyoming 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 few flights over any one area in any one year. WS-Wyoming 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-Wyoming 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-Wyoming aerial PDM data for FY14-18 show an average of 1.7 predators killed per hour of aerial PDM. A typical "pass" in which shots are taken at a predator 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 noise. WS flew an average of 2,506 hours per year in FY14-18, which corresponds to approximately 10.4 hours or less per year generating gunshot noises statewide. WS-Wyoming took an average of 4,247 predators per year during aerial PDM activities in FY14-18 in Wyoming. 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 17,000 statewide.

As part of the existing human environment, 253,479 hunting licenses were purchased by persons participating in hunting in Wyoming in 2017. These hunters spent 1.1 million recreation-days hunting, and killed about 112,500 big game animals, approximately 800 trophy game animals and more than 111,300 small and upland game animals (Wyoming Game and Game and Fish Department 2018). The number of shots fired by recreational hunters each year would, at a highly conservative estimate of 2 shots fired per animal killed, be more than 449,000. WS's contribution to overall gunshot noise in areas of wildlife habitat is less than 4% of the number of shots fired at wild animals in the state each year. Therefore, WS adds only a small amount of gunshot noise to that which occurs annually as part of the existing human environment in wildlife habitat in Wyoming.

Also, shooting from aircraft is virtually always at an extreme downward angle towards the ground (Larkin et al. 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.

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, non-targets are generally not close enough to be disturbed. The discharge of firearms will register much louder to animals that happen to be directly beneath or in close proximity to the aircraft, but the only wildlife generally within such close proximity are the target predators.

All of these factors suggest that gunshot noise from WS aerial PDM does not negatively impact wildlife in Wyoming.

3.2.1.8 Cumulative Impacts of Aircraft Overflight

Some public comments to similar EAs from other western states have raised the concern that WS-Wyoming 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-Wyoming also conducted aerial activities for wolf damage management during FY14-18. These activities were very limited in duration, frequency, and geographic scope, even when compared to the WS-Wyoming aerial PDM activities discussed above. During FY14-18, WS-Wyoming flew an average of 66.4 hours per year for gray wolves. Aerial gray wolf management in Wyoming represents less than 3% of additional flight hours over the aerial PDM analyzed above. This small increase does not alter our analyses or determinations in those sections.

The only other aerial PDM that occurs in Wyoming besides that performed by WS-Wyoming is by private individuals under permit from WDA. WDA-permitted aerial PDM by entities other than WS has been limited in terms of magnitude, frequency, and geographic scope. On average, 1,329 predators were killed per year by private pilots conducting aerial PDM during FY14-18, all of which were coyotes or red foxes. The average number of hours flown during this timeframe was 634 hours per year.

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-Wyoming 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-Wyoming may have the potential to marginally benefit several federal T&E species. The benefits from PDM would likely be to individuals, rather than local populations. These species include the black-footed ferret and Canada lynx. Management of coyotes would benefit black-footed ferrets by increasing the survival of released animals. Canada lynx may benefit from PDM if competing predators are removed from occupied lynx habitat.

PDM conducted by WS-Wyoming under this Alternative is expected to result in no indirect impacts to non-target species. Cumulative impacts under this Alternative are also expected to be negligible. Private citizens probably take more non-target wildlife than WS-Wyoming due to less training and experience. Even with this additional take by private citizens, cumulative impacts on non-target populations is negligible. WGFD 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 Wyoming, including T&E species and other sensitive species.

3.2.2 Alternative 2 – Lethal PDM Methods Used by WS-Wyoming Only for Corrective Control

Direct, Indirect, and Cumulative Impacts: Under Alternative 2, WS-Wyoming 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-Wyoming until damage has already occurred. WS-Wyoming 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 for traps, snares, and M-44s for corrective control was lower at sites with preventive aerial PDM than at sites without preventive aerial PDM. Foothold traps, snares, and M-44s pose a higher risk of capturing non-target species than does aerial PDM. Therefore, WS-Wyoming 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-Wyoming'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) compared to Alternative 1. Private individuals would not be restricted by APHIS-WS self-imposed protective measures (*e.g.*, not setting traps closer than 30 feet to livestock carcasses to avoid capturing scavenging birds, using pan-tension devices to exclude non-target animals). Slightly more non-target individuals, potentially including T&E species, are likely to be taken under this alternative than under Alternative 1, but fewer 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 Wyoming.

3.2.3 Alternative 3 – WS-Wyoming Provides Technical Assistance Only

Direct, Indirect, and Cumulative Impacts: Under Alternative 3, WS-Wyoming would not conduct direct operational PDM. Therefore, WS-Wyoming would not have any direct impact on non-target or T&E species. Under this alternative, PMDs and WGFD (depending on the species causing damage) would 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 self-imposed protective measures (*e.g.*, not setting traps closer than 30 feet to livestock carcasses to avoid capturing scavenging birds, using pan-tension devices to exclude non-target animals). WS-Wyoming would be able to mitigate some of the potential increases in non-target take by providing technical assistance. More non-target individuals, potentially including T&E species, are likely to be taken under this Alternative than under Alternatives 1 and 2, but fewer 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 Wyoming.

3.2.4 Alternative 4 – No PDM by WS-Wyoming

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Wyoming would not provide assistance with PDM and, therefore, WS-Wyoming would have no effect on non-target or T&E species from the use of PDM methods. PMDs and WGFD (depending on the species causing damage) would 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 self-imposed protective measures (*e.g.*, not setting traps closer than 30 feet to livestock carcasses to avoid capturing scavenging birds, using pan-tension devices to exclude non-target 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. 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 Wyoming.

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. 2011a). 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, less complex ecosystems have lower ecosystem resilience (Crooks and Soule 1999, Ritchie and Johnson 2009, Estes et al. 2011b, Beschta et al. 2013, 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, Wallach et al. 2010, Estes et al. 2011b, 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 the physical characteristics of the environment (Berger et al. 2001, Beschta and Ripple 2006, Ripple and Beschta 2006, Prugh et al. 2009, Estes et al. 2011b). 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 (Naiman and Rogers 1997, Beschta and Ripple 2006). 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 the result of a trophic cascade wherein the removal of an apex predator (*e.g.*, wolves or coyotes) results in increased populations of smaller predator(s) (*e.g.*, foxes, raccoons, feral cats), which may impact 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 fawns (Berger and Conner 2008). Mesopredators such as badgers, bobcats, and foxes have also been shown to increase in abundance when coyote populations are reduced (Robinson 1961, Nunley 1977, Crooks and Soule 1999).

3.3.1 Alternative 1 – Proposed Action/No Action Alternative – Continue WS-Wyoming 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-Wyoming may result in unintentional adverse impacts on biodiversity and ecosystem resilience by eliminating or reducing predator populations (Estes et al. 2011b, Bergstrom et al. 2014). However, Under Alternative 1, WS-Wyoming 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 has 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). During FY14-15, WS-Wyoming conducted PDM under agreements which comprise 53,125 mi^2, which is about 54% of the land area of Wyoming. WS-Wyoming only conducts activities on a small portion of the land acreage allowed under MOUs, annual WPs, Work Initiation Documents, or other comparable documents. As discussed in Chapter 1, WS-Wyoming typically conducts PDM on only 1/5 of the land area under agreement in any given year (USDA Wildlife Services 1997b); thus, we anticipate that WS-Wyoming would conduct PDM on less than 11% of the land area of Wyoming. In addition, the number of predators taken annually by WS-Wyoming 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-Wyoming 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-Wyoming'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-Wyoming operates in accordance with international, federal, and state laws and regulations enacted to ensure species viability. WS-Wyoming operates on a relatively small percentage of the land area of Wyoming, and take is only a small proportion of the total population of any species (Section 3.1). The analyses in this EA and in United States General Accounting Office (1990) indicate that the impacts of the current WS-Wyoming 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-Wyoming 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-Wyoming.

Henke (1992) and 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 in Wyoming 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-Wyoming. This, combined with the fact that cumulative take of coyotes is a low percentage, between 7.1% and 11.4% of Wyoming's estimated coyote population, and WS-Wyoming takes 6.15-9.17% of the estimated coyote population, indicates that PDM by Wyoming-WS has a minimal effect on ecosystems in Wyoming (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-Wyoming 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-Wyoming 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-Wyoming'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 (Crooks and Soule 1999, Prugh et al. 2009, Ritchie and Johnson 2009, Estes et al. 2011a, Bergstrom et al. 2014). WS-Wyoming has reviewed these studies but, for the most part, they are not applicable to the types of PDM proposed for Wyoming, 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, Estes et al. 2011b, Ripple and Beschta 2012, Ripple et al. 2013)). 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, 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, Guthrey 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-Wyoming 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 and may have caused a decline in the local jackrabbit population.

Henke (1995) reviewed literature related to coyote-prey interactions and concluded that short-term coyote removal efforts (<6 months per year) typically did not result in increases in 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, in turn leading 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 the relative abundance of badgers, bobcats, and gray foxes increased. However, sustained reductions in coyote populations (and presumably populations of 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).

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 predicides, 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 foxes traveled 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 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-Wyoming PDM activities achieve (approximately 7% 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, Ripple and Beschta 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. Kauffman et al. (2010) tested the behaviorally-mediated trophic cascades hypothesis in Yellowstone National Park, and found evidence that the failure of aspen to regenerate appeared to be more consistent with a gradual increase in elk numbers, rather than a shift in foraging behavior of elk in the absence of wolves. They also reported that aspen stands are not currently recovering in Yellowstone National Park, despite the reestablishment of a wolf population. Whereas Ripple and Beschta (2007) documented a correlation, these other studies show that it 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-Wyoming PDM.

As discussed in this EA, WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming program in sufficient numbers to result in substantive short-term local population reductions are coyotes.

Given the patchy and limited scope of WS-Wyoming PDM actions, repopulation of areas where PDM is conducted on coyotes 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 area 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-Wyoming, but the proportion of the coyote population removed in the Gese (2005) study was likely higher than typically occurs in Wyoming.

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 populations. Given the above factors, we believe it is unlikely that PDM actions by WS-Wyoming 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 hypothesized to selectively prey on mule deer with chronic wasting disease (CWD) (Miller et al. 2008, Krumm et al. 2009). 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, Wolfe et al. 2004). However, this has not to date been rigorously tested. Miller et al. (2008) concluded that, in spite of selective predation by mountain lions, predation did not decrease CWD transmission in Colorado. Moreover, CWD has spread in Colorado since the 1980s and now is detected in ungulates in 84 hunting license units or about half of Colorado (Colorado Parks and Wildlife 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.

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-Wyoming typically conducts PDM in less than 11% of the land area of Wyoming in any year, and takes only a small percentage (7.31%, FY14-18 annual average) 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/pronghorn populations were at or below the capacity of the habitat to support them. However, because WS-Wyoming only conducts PDM on less than 11% of the land area of the state and takes less than 10% 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 WGFD. If WGFD or a Tribe requested coyote removal for the purpose of enhancing pronghorn, elk, or deer herds, or greater sage-grouse populations, increases in the corresponding local populations of these species would be desirable and considered a beneficial impact on the human environment. In these situations, it is likely that coyote control would be more intense, and longer lasting, but would end when herd management goals were met. Even under 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 (Clark 1972, Wagner and Stoddart 1972, Keith 1974). 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 (U.S. Fish and Wildlife Service 1979b) 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-Wyoming Only for Corrective Control

Direct, Indirect, and Cumulative Impacts: Under Alternative 2, WS-Wyoming would not conduct preventive operational PDM. For most damage situations, this alternative would be similar to Alternative 1, because coyotes are the species most commonly targeted in preventive operations by WS-Wyoming, where the areas have 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 has occurred. Under this Alternative, WS-Wyoming would likely increase the use of traps, snares, and M-44s 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 lower take of coyotes for PDM (all PDM take, including take by WS-Wyoming and private entities). Under this Alternative, maximum likely cumulative take of coyotes would be negligibly lower than under Alternative 1. This negligible difference in the cumulative number of predators taken in Wyoming 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-Wyoming Provides Technical Assistance Only

Direct, Indirect, and Cumulative Impacts: Under Alternative 3 WS-Wyoming would not conduct direct operational PDM. Therefore, WS-Wyoming would not have any direct impact on ecosystem function. Under this alternative, PMDs and WGFD (depending on the species causing damage) would 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. Because WGFD intensively manages black bears and mountain lions, cumulative take for these species would be virtually identical to that under Alternative 1; WGFD would continue to manage these species for cumulative take, according to their targets.

Although technical assistance from WS-Wyoming 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-Wyoming

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Wyoming would not provide any direct operational work, or technical assistance with PDM. Therefore, WS-Wyoming 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-Wyoming poses little potential hazard to WS-Wyoming 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-Wyoming employees, the public, and non-target animals, including pets. Whereas some of the materials and methods used by WS-Wyoming 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 crew member training) directives. The proper use of PDM methods and safety is emphasized during trainings and via policies. The risk to the public is further reduced because most WS-Wyoming PDM methods are most commonly used 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-Wyoming 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 and are highly selective to target individuals or populations; such use has negligible impacts on the environment. The WS-Wyoming operational program properly disposes of any excess solid or hazardous waste and has been found to manage its chemicals appropriately (Office of Inspector General 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, (USDA Wildlife Services 2017a)) 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, (USDA Wildlife Services 2019d)), cable restraints (Chapter III, (USDA Wildlife Services 2019c)), foothold traps (Chapter IV,(USDA Wildlife Services 2019h)), aircraft use (Chapter V, (USDA Wildlife Services 2019b)), firearms (Chapter VI, (USDA Wildlife Services 2019g)), sodium cyanide (the active ingredient in M-44s) (Chapter VII, (USDA Wildlife Services 2019i), Large Gas Cartridges (Chapter VIII, (USDA Wildlife Services 2019e)), and DRC-1339 (Chapter XVI, (USDA Wildlife Services 2019f)). Similar risk analyses of 16 other APHIS-WS methods 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-Wyoming; however, if these risk analyses determine that additional mitigation measures are warranted, WS-Wyoming will implement those measures, as applicable. WS USDA Wildlife Services (2017a) 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 FY14-18, WS-Wyoming took an average of 146 coyotes and 30 red foxes per year with M-44s, which is approximately 2.3% of total annual coyote take, and 13% of red fox take. Considering the low number of coyotes and red foxes taken by WS-Wyoming using M-44s, even if WS-Wyoming loses use of the M-44 as a tool, other entities in Wyoming will still be able to utilize M-44s, or could compensate through more extensive use of traps, snares, and shooting.

WS-Wyoming strives to maintain the highest level of fair treatment of all people in Wyoming. In addition, WS-Wyoming strives to ensure that no potential effects from PDM activities in Wyoming are distributed unfairly among any communities or people in the state. Consequently, WS-Wyoming PDM activities are 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.

3.4.1.1 Human Safety Consequences of Aerial PDM Accidents

Accidents have occurred during WS aerial operations and are a major concern to WS and to the public. APHIS-WS 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 (USDA Wildlife Services 2019b). The use of aircraft by APHIS-WS and WS-Wyoming is quite different from 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-Wyoming 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 WS 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. WS pilots, aerial crew members and ground crews are trained in hazard recognition, and shooting is only conducted in safe environments. All of these factors 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. The risk to the public from WS-Wyoming aviation operations or accidents is extremely minimal, because of the sparsely inhabited and sparsely developed remote rangelands in which WS-Wyoming conducts aerial operations.

We analyzed aviation accidents beginning in 2007 and ending in 2016, because 2007 this was the first year ATOC became fully operational and 2016 is the year of the most recently published GAV figures (National Transportation Safety Board 2016). 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-Wyoming flies such a low number of hours annually (2,638 hours/year on average for all wildlife damage management during FY14-18), 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 11,728 in 2014 to as many as 15,027 in 2008 (USDA Wildlife Services 2019b). Total hours flown during 2007-16 was 134,544, with an average of approximately 13,454. Even these numbers are very low compared to GAV numbers, which averaged just over 21,000,000 during this timeframe, but they provide the best basis for comparison (National Transportation Safety Board 2016).

Nationwide, APHIS-WS had an accident rate of 4.46 (accidents per 100,000 hours flown) during calendar year 2007-2016, which is below the GAV rate of 6.6 during the same time frame (WS 2019, NTSB 2018). 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 compared to the GAV rate.

Some accidents by WS pilots have involved pilot error, whereas others were directly related to mechanical failure. Of the accidents between 2007 and 2016, 2 were due to pilot error, none were due to mechanical failure, and 3 were due to unknown causes (USDA Wildlife Services 2019b). 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.

The APHIS-WS accident rate is within or below the corresponding rate of general aviation and has not involved the general public. The risks are determined to be low and are 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-Wyoming's aerial PDM operations) to cause catastrophic ground fires and pollution as a result of spilled fuel and oil.

Catastrophic Ground Fires: WS aircraft have caused no major fires as a result of their operations. The only fire that was a result of WS aerial operations was in Utah in June 2007. The airplane crashed and ignited a fire, but the fire spread no further than the impact debris field and extinguished itself (USDA Wildlife Services 2019b). The period of greatest fire danger typically occurs during the summer months.

Fuel Spills and Environmental Hazards from Aviation Accidents: WS aircraft have caused no contamination due to leakage or spillage of petroleum products. There have been no reported fuel spills as a result of aircraft refueling operations either at fixed base operations or during field operations. No fuel or oil spillage has resulted from accident or incident and in all cases, fuel tanks, fuel lines, oil tanks and oil lines have remained intact with the exception of the accident in Utah in 2007. In this accident, the spilled fuel was consumed by the subsequent fire before any seepage could occur (USDA Wildlife Services 2019b).

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 (USDA Wildlife Services 2019b). Jet A fuel does not pose a large environmental problem if spilled. It is a straight chained hydrocarbon with little benzene present and microbes quickly break-down any spill residue through aerobic action (USDA Wildlife Services 2019b). The quantities used by WS aircraft are relatively small (52 gallon maximum in fixed-wing aircraft and 91 gallons 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 (USDA Wildlife Services 2019b).

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. Land management agencies such as the BLM and USFS generally require contaminated soil to be decontaminated or removed and properly disposed of. Given the size of 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 (USDA Wildlife Services 2019b).

Petroleum Biodegradation: Petroleum products degrade through volatilization and bacterial action, particularly when exposed to oxygen (U.S. Environmental Protection Agency 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 (U.S. Environmental Protection Agency 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, accidents involving WS aircraft 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 (USDA Wildlife Services 2019b).

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 foxes, mountain lions or other predatory wildlife with firearms by WS-Wyoming 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 (USDA Wildlife Services 2017c). This analysis is in the peer-review phase. When this analysis is finalized, WS-Wyoming will consider any analyses or recommendations not considered in this EA and make updates as necessary. If additional recommendations are provided in the risk analysis which would increase operations safety and be appropriate to WS-Wyoming's PDM program, WS-Wyoming will implement those recommendations, as appropriate.

The take of coyotes by WS-Wyoming using firearms would primarily involve the use of shotguns. However, the use of rifles would be employed in some situations (*e.g.*, calling and shooting, decoy dogs). 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 with misses by a shotgun or rifle, pass-throughs of the target animal, 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 directly exposed to high concentrations of lead shot accumulation due to 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-Wyoming'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

During FY14-18, WS-Wyoming took an average of 146 coyotes and 30 red foxes per year with M-44s, which is approximately 2.3% of total annual coyote take, and 13% of red fox take. The use of M-44s by WS-Wyoming is also low compared to nationwide use. The 176 predators taken on average by WS-Wyoming during FY14-18 represents 1.2% of the reported animals taken nationally in FY11-15 with M-44s (14,321 animals taken nationally by APHIS-WS; (USDA Wildlife Services 2019i)). There have been no exposures to people or pets due to WS-Wyoming's use of M-44s during FY14-18. Under Alternative 1, we anticipate similar, or slightly higher use of M-44s, up to 250 target animals per year. Because M-44s are most effective during the winter when predators are typically food stressed, WS-Wyoming does not use M-44s on public lands during peak times of recreational use, limiting the likelihood of any human or pet exposure. This strategy extends from the logical assumption that due to accessibility and weather severity, far fewer recreationists visit BLM lands in winter, and visitor use patterns are higher from spring through fall due to accessibility, advantageous weather, and the seasonality of certain activities, such as hunting in the fall. 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

The removal of aggressive or bold mountain lions under Alternative 1, some of which are repeat offenders, improves human safety, because these are the mountain lions which are likely to threaten or attack people. This work would only be conducted at the request of, and under the direction of WGFD.

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 or attack people, or break into homes and cars. This work would only be conducted at the request of, and under the direction of, WGFD.

3.4.1.7 Potential Impacts on Public Safety from Grizzly Bears Attacking People

The removal of aggressive or bold grizzly bears under Alternative 1, some of which are repeat offenders, improves human safety, because these are the bears which are likely to threaten or attack people. This work would only be conducted at the request of, and under the direction of WGFD.

3.4.1.8 Potential Impacts on Public Safety due to Zoonotic Diseases

Some commenters on similar environmental assessments 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.

3.4.1.9 Potential Impacts on Pets and Pet Safety

APHIS-WS and WS-Wyoming incorporate numerous protective measures (Section 2.11) to minimize the likelihood of impacts to pets and pet safety. During FY14-18, WS-Wyoming unintentionally captured 12 feral dogs, 11 of which were released alive and unharmed and one which was killed. We do not consider the nonlethal capture of 11, unharmed dogs over the course of five years to be a significant impact to the environment. While it is a very unfortunate event to lethally capture a single feral dog, over the course of the five year period of FY14-18, WS-Wyoming annually averaged no lethal take of feral dogs and the take of 2 feral dogs which were able to be freed and released unharmed. This highlights the rarity of WS-Wyoming capturing a feral dog that cannot be released unharmed. The lethal take of one feral dog by WS-Wyoming over the course of five years is not a significant impact on the environment. Still, APHIS-WS and WS-Wyoming strive to minimize such take whenever feasible.

Under Alternative 1, WS-Wyoming would remove coyotes and mountain lions from areas where they might otherwise attack or kill pets. In addition, coyotes killing or attempting to kill pets in urban/suburban areas are typically bold or aggressive individuals, which are likely to attack people (Baker and Timm 2017). These actions would be likely to save additional pets, in addition to protecting public safety.

Although not classically considered pets, WS-Wyoming could use trained hounds to capture or bay target mountain lions and black bears, as discussed in Section 3.6.1. The risk of injury or death to the hounds is discussed here because they are dogs. As discussed in Section 3.6.1, WS-Wyoming 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 hounds.

3.4.1.10 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 Wyoming and might be recommended by WS-Wyoming. Livestock protection dogs are generally large and aggressive breeds, such as Great Pyrenees, and these dogs might present a danger to humans and pets approaching protected flocks. As such, WS-Wyoming 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, the 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, the 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.

3.4.1.11 Summary of Direct, Indirect, and Cumulative Impacts on Human and Pet Health and Safety

The use of PDM methods by WS-Wyoming pose little potential direct hazard to WS-Wyoming 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 two decades to reduce the risk of PDM conducted by WS-Wyoming negatively impacting 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-Wyoming 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-Wyoming Only for Corrective Control

Direct, Indirect, and Cumulative Impacts: Under Alternative 2, WS-Wyoming would not conduct preventive operational PDM. As discussed previously (Section 3.1.1), some of this work would likely be conducted instead by PMDs, WGFD, and private individuals/entities. Preventive PDM by WS-Wyoming is typically conducted in areas of historic loss of livestock to coyotes, and, 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-Wyoming personnel, resulting in higher risks to public safety. Some livestock producers might become frustrated over the inability of WS-Wyoming 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-Wyoming 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 for 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-Wyoming Provides Technical Assistance Only

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS-Wyoming 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-Wyoming would not have any direct impact on public safety or pets in Wyoming. 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-Wyoming would not be able to respond to predator complaints involving human health and safety. 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.

WDA 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-Wyoming.

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, bears, 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 likely be significant negative impacts on human and pet health and safety.

3.4.4 Alternative 4 – No PDM by WS-Wyoming

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Wyoming would not provide assistance with PDM; therefore, there would be no direct impact by WS-Wyoming PDM on public safety, pets, or "environmental justice and executive order 12898." PMDs and WGFD would 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 experienced entities, the increased risk from coyotes, bears 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 4 would likely be significant. Under Alternative 4, there would likely be significant negative impacts on human and pet health and safety

3.5 Issue E: Effects of WS-Wyoming PDM on Use of Public Lands

Most recreationist concerns regarding PDM center around perceived impacts on hunting, photography, wildlife viewing, and enjoyment of seclusion. This issue was described, and WS-Wyoming's protective measures were addressed in, Chapter 2. WS-Wyoming conducts PDM mainly on two classes of federal public lands in Wyoming: BLM and USFS. The potential impacts of PDM on these lands are discussed below, including the potential impact of PDM on SMAs (including WSAs and RMAs). PDM is conducted mostly for the protection of livestock on grazing allotments in these areas.

3.5.1 Alternative 1 – Continue the Current Federal PDM Program

WS-Wyoming conducts PDM and other 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. Therefore, 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 wolf conflict management. The take of wolves has been omitted from this analysis, but the visits, hours, and acreage and allotments worked for wolf damage have 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-Wyoming 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-Wyoming PDM on BLM Lands

From FY14-18, WS-Wyoming had agreements in place covering 14,458,311 acres of BLM land. As previously discussed, WS-Wyoming actually conducts PDM on only about 1/5 of the total land area under agreement each year (WS 1997; see Section 3.1.1). As such, the actual BLM acreage with PDM is estimated at 15% of BLM lands. Approximately 85% of the area of BLM lands are not subject to WS-Wyoming PDM in any typical year. WS-Wyoming spent an average of 12,434 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, if recreationists were to simultaneously occupy all 14.5 million acres of BLM lands under agreement with WS in Wyoming, they would encounter a WS-Wyoming Specialist in one to two locations. And much of this work is conducted during the winter and early spring, when recreational use is even more limited. Some of this work is also conducted on landlocked portions of BLM lands, to which the public does not have access.

Another way to assess potential impacts is to analyze the frequency of visitations, or the number of days that WS-Wyoming personnel visited BLM lands. Each time a WS-Wyoming employee works on BLM lands, it is counted as a “person-day-visit”, regardless of how long the work was performed. During FY14-18, WS-Wyoming PDM averaged 2,660 person-day visits per year. The average time spent on BLM property per visit was approximately 4.5 hours. PDM conducted outside of grazing allotments is generally for alleviating threats to human safety and is relatively rare.

Average WS-Wyoming target PDM take on BLM lands during FY14-18 was 2,199 coyotes, 44 red foxes, 18 black-tailed jackrabbits, 16 raccoons, 8 badgers, 6 striped skunks, and 1 porcupine. There was also one bobcat and one mountain lion taken on BLM land during this 5-year timeframe. BLM manages 18.4 million acres in Wyoming, which is about 30% of the land area in Wyoming. Compared to the statewide averages (Table 3-2), the take on BLM lands was 35% of total take for coyotes, 19% for red fox, 2% for raccoons, 2% for striped skunks, 10% for porcupines, 23% for badgers, and 100% for black tailed jackrabbits. As discussed above, some BLM properties are on the same agreement as private lands. It is very likely that the reported take for black-tailed jackrabbits occurred on private lands that shared an agreement with BLM lands, given that the reported damage from black-tailed jackrabbits was property damage. Most WS-Wyoming PDM, and most predator take, occurs on private lands. These numbers validate that statement; predator take on BLM lands was much lower than or in line with the proportion of land in Wyoming managed by BLM (30%).

<u>Aerial PDM on BLM Lands</u>: The area of BLM lands under agreement where WS-Wyoming conducted aerial PDM averaged 9,845,282 acres (range 8,082,201-11,443,070) annually during FY14-18, which is about 54% of the total BLM lands in Wyoming. Because WS-Wyoming 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 11%. Therefore, in terms of acreage, more than 89% of the BLM lands were not exposed to any WS-Wyoming aerial PDM operations in any one year. Over the entire five-year period of FY14-18, WS-Wyoming flew 238 different areas under agreement comprised entirely or partially of BLM land, 187 (79%) of which saw 3 or fewer WS-Wyoming flights per year on average. Forty-five of the remaining 51 areas (19%) saw between 4 and 10 flights per year on average. The area that saw the most flights per year averaged 15.6 flights. In any given year, some allotments were flown more frequently, but no allotment was flown on more than 23 days in any one year. Thus, even on the most frequently flown allotments, WS-Wyoming aerial PDM occurred on only 6% of the days of the year. Moreover, the average flight time on any area under agreement containing BLM land was 2.1 hours on any given day; thus, the amount of time spent flying over any BLM land was considerably less than 6%. The average flying time per agreement containing BLM land was 4.4 hours per year, which is approximately 0.1% of the daytime hours in a year. The maximum flying time over any BLM allotment was 72.1 hours in FY16. Even this corresponds to less than 2% of the daylight hours in that year. 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. These data show that both the amount of time spent flying over BLM lands, and the percentage of land actually flown each year are low. We conclude that the impacts to BLM lands from aerial PDM are not significant.

3.5.1.2 WS-Wyoming PDM on USFS Lands

In FY14-18 WS-Wyoming had agreements in place covering 4,882,975 acres of USFS land. As previously discussed, WS-Wyoming actually conducts PDM on only about 1/5 of the total lands under agreement each year ((USDA Wildlife Services 1997c); see Section 3.1.1). As such, the actual acreage with PDM is estimated at 10.6% of USFS lands. These numbers demonstrate that WS-Wyoming conducts PDM on a small percentage of USFS lands, and that more than 89% of the area of USFS lands is not subject to WS-Wyoming PDM in any typical year. WS-Wyoming spent an average of 1,554.5 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-Wyoming PDM averaged 304 person-day visits per year during FY14-18.

One person from WS-Wyoming 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 merely an indication that WS-Wyoming personnel visited USFS lands on a particular day. The average time spent on USFS property per visit was 5.1 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 annual WS-Wyoming PDM take on USFS lands during FY2014-2018 was 98 coyotes, 2 raccoons, and 2 striped skunks. There were also 3 red foxes, 2 feral dogs, 2 black bears, and 1 badger taken on USFS land during this 5-year timeframe. USFS manages 9.2 million acres in Wyoming, which is about 15% of the land area in Wyoming. Compared to the statewide averages (Table 3-1), the take on USFS lands was only 1.3% of total predator take: 1.6% for coyotes, 0.2% for raccoons, 0.6% for striped skunks, 0.3% for red fox, 20% for black bear, and 0.6% for badgers. As discussed earlier, most WS-

Wyoming PDM, and most predator take, occurs on private lands. These numbers reflect that trend; predator take on USFS lands (1.3% of total predator take) was much lower than the proportion of land in Wyoming managed by USFS (15%). Black bear take on USFS lands represented a higher proportion of the statewide take of this species (20%) than would be expected based on land area (15%). This is likely due to differences in habitat preferences. Black bears prefer heavily forested habitats.

Aerial PDM on USFS Lands: WS-Wyoming conducted aerial PDM on 897,512 acres of USFS lands (range 674,977 in FY15 to 1,333,591 in FY16) per year during FY14-FY18, which was less than 10% of all USFS lands in Wyoming. Therefore, more than 90% of USFS lands are not exposed to any WS-Wyoming aerial PDM in any typical year. Even the highest acreage flown constitutes less than 15% of the 9.2 million acres of USFS lands in Wyoming. Because only about 1/5 of the total acreages on WS-Wyoming agreements is actually flown (USDA Wildlife Services 1997c), we estimate that the amount of USFS lands flown by WS-Wyoming in any typical year is below 2%. Thus, more than 98% of USFS lands were not exposed to any WS-Wyoming aerial PDM in a typical year.

The average number of days flown per year on any USFS allotment ranged from 0.2 to 5.2 flights. Of the 36 areas under agreement flown at some time over the five-year period (FY14-18), 33 (92%) were exposed to fewer than 3 flights per year on average. The other 3 allotments (8%) were flown between 3.2 and 5.2 times per year. Although some areas were flown more times within any given year, no area was flown over more than 8 days in any one year. This constitutes a very small fraction (2.2%) of the 365 days in a year. Moreover, the average flight time on any USFS allotment was 2 hours per flight-day; thus, the amount of time spent flying over any USFS allotment was considerably less than 2.2%.

3.5.1.3 Overall Impacts on Public Lands Exposed to WS-Wyoming Aerial PDM

During FY14-FY18, WS-Wyoming flew an average of 2,163 hours over an average of 25,266 mi^2 (yearly range 22,780 to 27,632 mi^2) of properties under WS-Wyoming agreements, or about 26% (range 23% to 28%) of the land area of the State in any given year. Of the 2,163 hours flown annually in that 5 year period, 42% occurred over private lands (average of 1,800 hours), 29% over State Lands (average of 1,237 hours), 25% over BLM lands (average of 1,073 hours), and less than 4% over other lands (primarily USFS lands) (average of 151.9 hours). The average hours flown over specific land classes totals to more than the total hours flown because flights are often conducted in areas where multiple land classes are covered under a single WS-Wyoming cooperative agreement. The amount of time spent flying over the properties where aerial damage management was conducted averaged 5.1 minutes/mi^2 in any given year. Therefore, on the portion of the landscape exposed to aerial operations, such overflights occur during only a tiny fraction of the time in an entire year.

Table 3-18 shows data on WS-Wyoming aerial operation hours by county during FY14-18. WS-Wyoming aerial operations are relatively evenly distributed across counties. Sweetwater, Fremont, and Carbon Counties are the three largest counties in the state and rank 2nd, 1st, and 4th, respectively, in average annual hours flown between FY14 and FY18. WS-Wyoming did not conduct any aerial operations in Teton or Platte Counties between FY 14 and FY18.

3.5.1.4 Effects of WS-Wyoming PDM on Special Management Areas

A number of different types of Federal lands are Special Management Areas (SMA) and occur within the analysis area, including WAs, WSAs, RMAs, National Historic Sites, and Areas of Critical Environmental Concern. All of these land types currently have special designations because of their unique characteristics and therefore, may require special considerations for conducting PDM. WS-

Wyoming 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-Wyoming to conduct PDM activities in SMAs under certain limitations. As such, WS-Wyoming has conducted PDM on some of these areas.

Table 3-18. Average annual aerial operations hours for all wildlife damage management activities in Wyoming by County during federal fiscal years 2014-2018.

County	**Average Hours**	**Percentage of Total**
Albany	89.58	4.14%
Big Horn	133.12	6.15%
Campbell	144.7	6.69%
Carbon	158.28	7.32%
Converse	18.28	0.85%
Crook	116.24	5.37%
Fremont	244.06	11.28%
Goshen	37.82	1.75%
Hot Springs	170.76	7.89%
Johnson	15.14	0.7%
Laramie	13.04	0.6%
Lincoln	148.28	6.86%
Natrona	18.66	0.86%
Niobrara	69.06	3.19%
Park	128	5.92%
Platte	0	0%
Sheridan	1.46	0.07%
Sublette	108.98	5.04%
Sweetwater	218.38	10.1%
Teton	0	0%
Uinta	98.16	4.54%
Washakie	141.18	6.53%
Weston	89.78	4.15%
Total	**2,163**	**100%**

WS-Wyoming complies with internal guidelines and policies when conducting PDM in these areas. WS-Wyoming 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 WGFD regulations. These activities are not restricted by BLM or USFS in most SMAs.

WS-Wyoming 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 and is covered by WS-Wyoming's protective measures to ensure no adverse effects in SMAs. WS-Wyoming 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-Wyoming also complies with internal agency guidelines and policies when conducting PDM in these areas. WS-Wyoming will conduct PDM in WAs only when and where specifically authorized by the land management entity on a case by case basis. PDM activities conducted in all other SMAs, including WSAs and RMAs, will be conducted in accordance with the

MOUs and WPs between WS-Wyoming and the respective land management agencies, and all enacted rules and regulations that are applicable to WS-Wyoming.

The Current Program Alternative has a minimal effect on SMAs, such as WAs, WSAs, research natural areas, and RMAs (such as campgrounds and trailheads).

BLM SMA: WS-Wyoming PDM in WAs, WSAs, RMAs and other SMAs conforms to all federal and state laws and regulations that have been determined to apply to WS-Wyoming activities. WS-Wyoming 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[1]. 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.

WS-Wyoming coordinates annually with the BLM to identify any conflicts that WS-Wyoming activities might have with established management plans or goals for SMAs. If WS-Wyoming activities are found to conflict with such management plans or goals, then WS-Wyoming will either refrain from continuing such activities or refine its NEPA analysis as appropriate in coordination with the BLM.

USFS SMA: WS-Wyoming follows policies outlined in the USFS Manual, particularly Section 2323, and the National MOU between USFS and WS-Wyoming when conducting PDM in USFS SMAs such as WAs and WSAs. Additionally, the LRMP provides guidance for USFS to determine if PDM objectives are compatible with land management objectives. For example, WS-Wyoming does not conduct PDM in USFS specially designated areas (*e.g.*, trailheads, campgrounds), except to address emergency human health situations. Proposed WS-Wyoming WPs 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-Wyoming PDM to have any adverse effects 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 WGFD. PDM in SMAs would not impair the values of such areas and the intent of Congress designating them as such. WS-Wyoming PDM activity on USFS SMAs has been very limited.

Summary of Potential Impacts to SMAs in Wyoming: Wyoming has many SMAs. A list of the majority of SMAs in Wyoming is provided in Table 3-19. These areas were analyzed to determine potential impacts of the current WS-Wyoming 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-Wyoming might use on such areas (*e.g.*, aerial PDM, ground-based shooting).

[1] 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 3-19. Special Management Areas (SMAs) in Wyoming (list is not intended to be comprehensive).

WYOMING WILDERNESS AREAS / NATIONAL PARKS / NATIONAL MONUMENTS / HISTORIC SITES / NATIONAL TRAILS / WILDLIFE REFUGES		
Absaroka-Beartooth Wilderness Area (USFS)	Savage Run Wilderness Area (USFS)	Nez Perce (Nee-Me-Poo) Trail (NPS)
North Absaroka Wilderness Area (USFS)	Platte River Wilderness Area (USFS)	Oregon Trail (NPS)
Washakie Wilderness Area (USFS)	Yellowstone National Park (NPS)	Pony Express Trail (NPS)
Popo Agie Wilderness Area (USFS)	Grand Teton National Park (NPS)	National Elk Refuge (USFWS)
Fitzpatrick Wilderness Area (USFS)	Fossil Butte National Monument (NPS)	Cokeville Meadows National Wildlife Refuge (USFWS)
Jedediah Smith Wilderness Area (USFS)	Devils Tower National Monument (NPS)	Seedskadee National Wildlife Refuge (USFWS)
Teton Wilderness Area (USFS)	Fort Laramie National Historic Site (NPS)	Pathfinder National Wildlife Refuge (USFWS)
Gros Ventre Wilderness Area (USFS)	Flaming Gorge National Recreation Area (NPS)	Mortenson Lake National Wildlife Refuge (USFWS)
Bridger Wilderness Area (USFS)	Big Horn Canyon National Recreation Area (NPS)	Hutton Lake National Wildlife Refuge (USFWS)
Cloud Peak Wilderness Area (USFS)	Continental Divide Trail (NPS)	Bamforth National Wildlife Refuge (USFWS)
Huston Park Wilderness Area (USFS)	California Trail (NPS)	
Encampment River Wilderness Area (USFS)	Mormon Pioneer Trail (NPS)	
WILDERNESS STUDY AREAS		
Adobe Town WSA (BLM High Desert District)	Twin Buttes WSA (BLM High Desert District)	Medicine Lodge WSA (Wind River/Bighorn Basin District)
Alkali Basin/East Sand Dunes WSA (BLM High Desert District)	Whitehorse Creek WSA (BLM High Desert District)	Miller Spring WSA (Wind River/Bighorn Basin District)
Alkali Draw WSA (BLM High Desert District)	Fortification Creek WSA (BLM High Plains District)	Owl Creek WSA (Wind River/Bighorn Basin District)
Bennett Mountain WSA (BLM High Desert District)	Gardner Mountain WSA (BLM High Plains District)	Pryor Mountain WSA (Wind River/Bighorn Basin District)
Buffalo Hump WSA (BLM High Desert District)	North Fork WSA (BLM High Plains District)	Red Butte WSA (Wind River/Bighorn Basin District)
Devil's Playground WSA (BLM High Desert District)	Alkali Creek WSA (Wind River/Bighorn Basin District)	Savage Peak WSA (Wind River/Bighorn Basin District)
Encampment River Canyon WSA (BLM High Desert District)	Bobcat Draw Badlands WSA (Wind River/Bighorn Basin District)	Sheep Mountain WSA (Wind River/Bighorn Basin District)
Ferris Mountain WSA (BLM High Desert District)	Bighorn Tack-On WSA (Wind River/Bighorn Basin District)	Split Rock WSA (Wind River/Bighorn Basin District)
Honeycomb Buttes WSA (BLM High Desert District)	Cedar Mountain WSA (Wind River/Bighorn Basin District)	Sweetwater Canyon WSA (Wind River/Bighorn Basin District)
Lake Mountain WSA (BLM High Desert District)	Copper Mountain WSA (Wind River/Bighorn Basin District)	Trapper Creek WSA (Wind River/Bighorn Basin District)
Oregon Buttes WSA (BLM High Desert District)	Dubois Badlands WSA (Wind River/Bighorn Basin District)	Whiskey Mountain WSA (Wind River/Bighorn Basin District)
Prospect Mountain WSA (BLM High Desert District)	Honeycombs WSA (Wind River/Bighorn Basin District)	Palisades WSA (USFS)
Raymond Mountain WSA (BLM High Desert District)	Lankin Dome WSA (Wind River/Bighorn Basin District)	Shoal Creek WSA (USFS)
Red Creek Badlands WSA (BLM High Desert District)	McCullough Peaks WSA (Wind River/Bighorn Basin District)	High Lakes WSA (USFS)
Red Lake WSA (BLM High Desert District)		
Sand Dunes WSA (BLM High Desert District)		
Scab Creek WSA (BLM High Desert District)		
South Pinnacles WSA (BLM High Desert District)		
AREAS of CRITICAL ENVIRONMENTAL CONCERN		
Sheep Mountain Anticline (BLM Cody Field Office)	Alcova Fossil Area (BLM Casper Field Office)	Upper Muddy Creek Watershed/Grizzly Area (BLM Rawlins Field Office)
Brown/Howe Dinosaur Area (BLM Cody Field Office)	Lander Slope (BLM Lander Field Office)	Blowout Penstemon (BLM Rawlins Field Office)
Carter Mountain (BLM Cody Field Office)	Red Canyon (BLM Lander Field Office)	Cave Creek Cave (BLM Rawlins Field Office)
Five Springs Falls (BLM Cody Field Office)	Whiskey Mountain (BLM Lander Field Office)	Cedar Canyon (BLM Rock Springs Field Office)
Little Mountain (BLM Cody Field Office)	Beaver Rim (BLM Lander Field Office)	Greater Red Creek (BLM Rock Springs Field Office)
Clarks Fork Canyon (BLM Cody Field Office)	East Fork (BLM Lander Field Office)	Greater Sand Dunes (BLM Rock Springs Field Office)
Paleocene, Eocene Thermal Maximum (BLM Cody Field Office)	Green Mountain (BLM Lander Field Office)	Natural Corrals (BLM Rock Springs Field Office)
Sheep Mountain (BLM Cody Field Office)	South Pass Historical Landscape (BLM Lander Field Office)	Oregon Buttes (BLM Rock Springs Field Office)
Big Cedar Ridge (BLM Worland Field Office)	Twin Creek (BLM Lander Field Office)	Pine Springs (BLM Rock Springs Field Office)
Red Gulch Dinosaur Tracksite (BLM Worland Field Office)	Raymond Mountain (BLM Kemmerer Field Office)	White Mountain Petroglyphs (BLM Rock Springs Field Office)
Spanish Point Karst (BLM Worland Field Office)	Bridger Butte (BLM Kemmerer Field Office)	South Pass (BLM Rock Springs Field Office)
Upper Owl Creek (BLM Worland Field Office)	Whoopup Canyon (BLM Newcastle Field Office)	Special Status Plants (BLM Rock Springs Field Office)
Welch Ranch (BLM Buffalo Field Office)	Rock Creek (BLM Pinedale Field Office)	Steamboat Mountain (BLM Rock Springs Field Office)
Pumpkin Buttes (BLM Buffalo Field Office)	Beaver Creek (BLM Pinedale Field Office)	
Jackson Canyon (BLM Buffalo Field Office)	Como Bluff (BLM Rawlins Field Office)	
Salt Creek Hazardous (BLM Casper Field Office)	Sand Hills (BLM Rawlins Field Office)	
	Jep Canyon (BLM Rawlins Field Office)	
	Shamrock Hills (BLM Rawlins Field Office)	
STATE PARKS		
Bear River State Park (WDSPHS)	Edness K. Wilkins State Park (WDSPHS)	Hot Springs State Park (WDSPHS)
Boysen State Park (WDSPHS)	Glendo State Park (WDSPHS)	Keyhole State Park (WDSPHS)
Buffalo Bill State Park (WDSPHS)	Guernsey State Park (WDSPHS)	Seminoe State Park (WDSPHS)
Curt Gowdy State Park (WDSPHS)	Hawk Springs State Park (WDSPHS)	Sinks Canyon State Park (WDSPHS)

RECREATION MANAGEMENT AREAS		
Hogan/Luce Campground (BLM Cody Field Office)	National Historic Trails Interpretive Center (BLM Casper Field Office)	Scab Creek Campgrounds and Trailhead (BLM Pinedale Field Office)
North Shoshone River Access (BLM Cody Field Office)	Muddy Mountain Environmental Education Area (BLM Casper Field Office)	Boulder Lake Recreation Area (BLM Pinedale Field Office)
Five Springs Falls Campground (BLM Cody Field Office)	Golden Current Campground (BLM Casper Field Office)	CCC Ponds Recreation Area (BLM Pinedale Field Office)
Red Gulch Dinosaur Tracksite (BLM Worland Field Office)	Miles Landing (BLM Casper Field Office)	Warren Bridge Recreation Area (BLM Pinedale Field Office)
Duck Swamp Environmental Education Area (BLM Worland Field Office)	White Tail Campground (BLM Casper Field Office)	Warren Bridge Campground (BLM Pinedale Field Office)
Castle Gardens Scenic Area (BLM Worland Field Office)	Petes Draw Campground (BLM Casper Field Office)	New Fork River Campground (BLM Pinedale Field Office)
Welsh Ranch (BLM Buffalo Field Office)	Prior Flat Campground (BLM Rawlins Field Office)	Pine Creek Ski Area (BLM Kemmerer Field Office)
Mosier Gulch Recreation Area (BLM Buffalo Field Office)	Bennett Peak Campground (BLM Rawlins Field Office)	Pine Creek Campground (BLM Kemmerer Field Office)
Dry Creek Petrified Tree (BLM Buffalo Field Office)	Corral Creek Campground (BLM Rawlins Field Office)	Names Hill River Access (BLM Pinedale Field Office)
Weston Hills Recreation Area (BLM Buffalo Field Office)	Encampment River Campground (BLM Rawlins Field Office)	Fontenelle Creek Recreation Area (BLM Kemmerer Field Office)
Burnt Hollow Recreation Area (BLM Buffalo Field Office)	Teton Reservoir (BLM Rawlins Field Office)	Tailrace Campground (BLM Kemmerer Field Office)
Outlaw Cave Recreation Area (BLM Buffalo Field Office)	Rim Lake (BLM Rawlins Field Office)	Weeping Rock Campground (BLM Rock Spring Field Office)
Middle Fork of the Powder River Campground (BLM Worland Field Office)	The Dugway (BLM Rawlins Field Office)	State Creek Camp Sites (BLM Kemmerer Field Office)
Grave Springs Campground (BLM Casper Field Office)	Wild Horse Point (BLM Lander Field Office)	Killpecker Sand Dunes Off-Highway Vehicle Area (BLM Rock Springs Field Office)
Buffalo Creek Campground (BLM Casper Field Office)	Cottonwood Campground (BLM Lander Field Office)	Three Patches Recreation Area (BLM Rock Springs Field Office)
Castle Gardens Petroglyph Site (BLM Lander Field Office)	South Pass City State Historic Site (BLM Rock Springs Field Office)	
Goldeneye Reservior (BLM Casper Field Office)	Big Atlantic Gulch Campground (BLM Lander Field Office)	
Poison Spider Bentonite Pit (BLM Casper Field Office)	Atlantic City Campground (BLM Lander Field Office)	
	Sweetwater River Campgrounds (BLM Rock Springs Field Office)	

PDM as conducted by WS-Wyoming does not have an impact on ecological, cultural, historical, geological, paleontological, or plant resources because habitat is not impacted by WS-Wyoming during PDM. WS-Wyoming PDM also does not impact amphibians, fish, invertebrates, or plants in Wyoming. PDM has no potential to affect scenic qualities and has only minor potential to affect aesthetic and recreational qualities of SMAs, as such work is limited in scope and duration, as discussed in this section. Although WS-Wyoming has the potential to take some species of birds and mammals during PDM, WS-Wyoming 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 3-17). If a 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 in such places.

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 conducted 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 WP, and WS-Wyoming would abide by those restrictions unless provided with a special exemption.

3.5.1.5 Conclusions for Direct, Indirect, and Cumulative Impacts of WS-Wyoming PDM on Public Lands under Alternative 1.

WS-Wyoming aerial PDM on specific parcels of public lands in Wyoming has been infrequent, of short duration, and has been conducted over a small proportion of the total public lands in the State. Aerial

PDM flights or other PDM activities were not conducted on a large portion of BLM and USFS lands, and these actions were limited to only a small fraction of time in any given year. Most recreationists are totally unaware of PDM actions, and the quality of their outdoor experience is unaffected. Thus, WS-Wyoming PDM has had no significant impact on recreational uses.

WS-Wyoming coordinates work plans with the BLM and USFS to further reduce the potential for impacts on recreation on public lands, including SMAs. During such coordination activities, the Federal land managers and WGFD personnel inform WS-Wyoming about specific locations where mitigation or restrictions on WS-Wyoming 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-Wyoming conducts PDM. Furthermore, upland game and other high-use hunting areas are delineated by USFS or BLM. WS-Wyoming 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 WPs and on WP 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 WPs. 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-Wyoming'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 Wyoming which for viewing abundant wildlife. In fact, WS-Wyoming 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-Wyoming 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. 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 (late winter and early spring), aerial PDM is the method of choice, because of limited access due to muddy or snow-covered roads. Many recreationists, as well as WS-Wyoming 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-Wyoming expects continued annual variation in the specific allotments and acreages on which PDM is conducted, and in the numbers of predators taken. However, WS-Wyoming does not anticipate any substantive future increases in these acreages, or the 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. Under Alternative 1, there would be no significant cumulative impacts on public lands.

3.5.2 Alternative 2 – Lethal PDM Methods Used by WS-Wyoming Only for Corrective Control

Direct actions by WS-Wyoming would minimally affect recreationists under this Alternative (similar to Alternative 1). In areas where lethal preventive control would have been used by WS-Wyoming under Alternative 1, PDM would likely be implemented by PMDs, resource owners, or private contractors instead, or by WS-Wyoming 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-Wyoming. Instead, private individuals/entities would likely conduct most preventive PDM. More losses would likely be incurred by resource owners with less availability of 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-Wyoming would still conduct lethal control after damage has occurred. WS-Wyoming 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-Wyoming Provides Technical Assistance Only

Under this alternative, WS-Wyoming would not have any direct impact on recreational use of public lands in Wyoming. 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-Wyoming 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-Wyoming

Under this alternative, WS-Wyoming would not provide assistance with PDM; therefore, there would be no direct Federal impact on recreation. However, PMDs and WGFD (depending on the species involved) 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-Wyoming 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 humaneness 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-Wyoming would continue the current program of integrated and adaptive PDM, using the Decision Model, protective measures, and APHIS-WS policies and directives. WS-Wyoming PDM activities occur on a limited proportion of the total land area in Wyoming (<11% in FY14-18), and the proportion of populations of various predator species removed through WS-Wyoming PDM activities is typically small (Section 3.1.1). In localized areas where WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming 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. Responses 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 human population espousing mutualistic values (George et al. 2016) will exhibit concern 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 1980) 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-Wyoming 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 with, 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.

Schmidt et al. (1996) 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*" (American Veterinary Medical Association 2013a). 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 (American Veterinary Medical Association 2013a), "*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*" (American Veterinary Medical Association 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*" (American Veterinary Medical Association 2013a). 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 indicate that this is the case for foxes 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 foxes, and badgers becoming orphaned. When WS-Wyoming 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-Wyoming'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 foxes, 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 time 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 within the constraints imposed by current technology. WS-Wyoming personnel are concerned about animal welfare. WS-Wyoming 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 render products and methods more efficient, 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-Wyoming supports the most humane, selective, and effective damage management techniques, and would continue to incorporate advances into program activities under Alternative 1. WS-Wyoming 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 are designed to ensure that WS-Wyoming'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-Wyoming'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.

Some publications have expressed concerns about the conclusions and thresholds established through the BMP testing process (Rochlitz et al. 2010, Virgós et al. 2016). However, trapping BMPs are based on scientific evaluations of humaneness, efficiency, selectivity, practicality, and safety, and are updated periodically. 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) (Association of Fish and Wildlife Agencies 2006). Modern BMPs are based on more than 20 years of scientific research (Association of Fish and Wildlife Agencies 2006), and provide a standard framework for future updates as new traps and components are developed. Groups such as the American Association of Wildlife Veterinarians and the American Veterinary Medical Association support the use of BMP traps in wildlife management. These BMPs provide a more useful method for identifying the most humane traps. In addition to BMP trap practices, WS-Wyoming personnel follow USFWS Biological Opinions (Sections 1.14.4 and 3.2.1.1) and several protective measures (Section 2.11.2) to minimize capture of nontarget species.

Use of foot snares to catch mountain lions and bears: Foot snares are used to capture mountain lions and bears for research and wildlife damage management in Wyoming. Foot snares are an effective tool, with 98% of mountain lions captured without debilitating injuries (Logan *et al.* 1999). Snares are set on the ground where lions or bears use trails, or around carcasses killed by the lions or bears. The snares capture the animal around the foot or just above the foot capturing the animal alive. The design 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-Wyoming uses foot snares infrequently, as WGFD is the primary agency authorized to respond to mountain lion and bear damage conflicts.

Use of hounds to catch mountain lions and bears: Hounds are used to capture mountain lions and bears for research, wildlife damage management. In Wyoming, hounds are also used to pursue regulated sport hunting purposes. A number of 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 Jalkotzky 1992, Logan et al. 1999, Logan 2015).

WS-Wyoming achieves much lower injury and death rates while using hounds. WS-Wyoming uses hounds to capture mountain lions and black bears to alleviate depredations on livestock and wild ungulates of management concern (*e.g.*, mule deer). WS-Wyoming field specialists could also be requested to capture mountain lions using hounds for research projects. When experienced personnel capture mountain lions with hounds it can be a safe and efficient method. One of the reasons for the low injury and death rates is that WS 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 the low injury and death rates is that hounds used by WS-Wyoming are equipped with GPS and VHF radio collars, which allow 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 employed by WS-Wyoming using 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, Harlow et al. (1992) looked at cortisol levels in mountain lions that had been chased by hounds and their results suggested multiple chase events in a single day are more stressful than a single chase event. WS-Wyoming generally only chases target animals once, so the energetic costs are unlikely to manifest in any suffering by, or loss of fitness to, 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 determining factor in 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 employs 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" . 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 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; specific effects of individual actions are considered by WS-Wyoming employees through the use of the WS Decision Model to select methods that are effective and appropriate for the given location. WS-Wyoming 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-Wyoming 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-Wyoming PDM program meets the six "Gold Standard" criteria of Littin et al. (2004), and is considered ethically sound.

The issue of ethics has evolved over time (Perry and Perry 2008). WS has numerous policies, directives, and protective measures that provide direction to staff to devise 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 is sometimes raised is the purported impact that PDM might have on sportsmen. Game and non-game wildlife populations are not significantly impacted by WS PDM take, allowing hunters and trappers ample opportunities for pursuit during seasons set by WGFD for trophy game and furbearing species and year-round recreational opportunities for legislatively designated predatory animal species. WS PDM is highly directed at 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 Wyoming (usually less than 11% of the State). Private fur harvesters tend to hunt and trap 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. Moreover, most coyote take by WS-Wyoming (69% in FY14-18) is on private land, where the landowners generally value livestock protection over coyote hunting opportunities. 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 red fox hunting opportunities.

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 these undertakings present concerns for cultural properties. In most cases, WDM activities have little potential to cause adverse effects to sensitive historical and cultural resources, because the methods utilized do not involve ground disturbance. If an individual PDM activity with the potential to affect 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 National Historic Preservation Act (NHPA) and Advisory Council regulations 26 CFR Part 800 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-Wyoming employee, the appropriate Tribe or official would be notified. PDM activities will primarily 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-Wyoming. However, in consideration of Wyoming's Native Americans, WS-Wyoming has included all of the recognized Tribes in Wyoming 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-Wyoming Only for Corrective Control

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS-Wyoming would not conduct preventive PDM. Because WS-Wyoming preventive PDM is typically limited to coyotes in certain circumstances (see Section 3.1.2 for example), coyote take by WS-Wyoming would decrease under this alternative, whereas the take of all other predator species would remain the same. Some increased PDM by PMDs, 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-Wyoming. However, private individuals would increase their use of foot-hold traps, snares, and shooting for preventive control activities. Private aerial PDM under this Alternative may increase, but it would be unlikely to increase to levels similar to Alternative 1. Lack of preventive predation management with aerial PDM may also result in increases in WS-Wyoming'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-Wyoming 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 regard to these sociocultural issues.

3.6.3 Alternative 3 – WS-Wyoming Provides Technical Assistance Only

Direct, Indirect, and Cumulative Impacts: Under this Alternative, WS-Wyoming would not conduct any direct PDM, so there would be no direct impacts by WS-Wyoming. However, PMDs or WGFD (depending on the species causing damage), 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-Wyoming would provide only technical assistance to people who request assistance with predator damage. This includes verbal or written consultation on alleviating predator damage using a variety of methods, such as animal husbandry, animal behavior modification, habitat management, and 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-Wyoming, would conduct lethal PDM on their own without receiving technical assistance from WS-Wyoming. 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 trap, 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 also be likely to occur. 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-Wyoming in Alternative 1 for other reasons. WS-Wyoming is accountable to public input, and interest groups often focus their attention and opposition to PDM activities employed by WS-Wyoming. 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-Wyoming. 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 some animal rights activists and to some animal welfare advocates because WS-Wyoming 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 regard to these sociocultural issues.

3.6.4 Alternative 4 – No PDM by WS-Wyoming

Direct, Indirect, and Cumulative Impacts: Under this alternative, WS-Wyoming would not conduct PDM, and methods viewed by some persons as inhumane would not be used by WS-Wyoming. 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), PMDs or WGFD (depending on the species causing damage), 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-Wyoming technical assistance program which would otherwise recommend more humane methods in some cases.

Individuals who would conduct PDM in the absence of a WS-Wyoming 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-Wyoming is required.

PDM for black bears, grizzly bears or mountain lions would be responded to by WGFD. There would be no change in humaneness. Private individuals would no longer receive training from WS-Wyoming, nor would federal research efforts focused on improved humaneness, selectivity, and nonlethal methods be implemented into PDM in Wyoming. Private individuals experiencing resource losses, who are no longer provided professional assistance from WS-Wyoming, 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 under Alternative 1 for other reasons. WS-Wyoming is accountable to public input, and interest groups often focus their attention and opposition to PDM activities employed by WS-Wyoming. 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-Wyoming. 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 to comply with policies or regulations that are mandated in the case of WS-Wyoming. 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 regard to these sociocultural issues.

3.7 Evaluation of Alternatives to Meet the Goals and Objectives of APHIS-WS and WS-Wyoming

Several of the goals and objectives of APHIS-WS and WS-Wyoming 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 3-20, with the likelihood that each of the four Alternatives analyzed in detail would be likely to accomplish them. This table answers the question: W*ould the alternatives achieve the goals and objectives of APHIS-Wildlife Services and Wildlife Services-Wyoming?* 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-Wyoming discussed in this EA would likely be effectively achieved (Table 3-20). The achievement of some of these goals is dependent upon the specific performance of the WS-Wyoming 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-Wyoming 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-Wyoming Only for Corrective Control

Under Alternative 2, WS-Wyoming 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-Wyoming would be limited in the ability to respond in a timely manner to all requests for assistance. For all species other than coyotes, we would likely be able to respond in a timely manner. But for areas where coyotes have caused historic damage, and preventive PDM would be warranted, WS-Wyoming would not be able to respond appropriately to such requests. Thus, we would only be "somewhat" able to achieve this objective.

WS-Wyoming would also only be somewhat able to appropriately resolve predator damage problems, because in those cases where preventive coyote PDM would be warranted, WS-Wyoming 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-Wyoming for preventive 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-Wyoming 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 offending coyotes.

Table 3-20. 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-Wyoming, as described in this Environmental Assessment?

Issues	**Alternative 1** *Continue Predator Management Program*	**Alternative 2** *Lethal Predator Management for Corrective Action Only*	**Alternative 3** *Provide Technical Assistance Only*	**Alternative 4** *No Predator Damage Management by WS*
Provide for WS personnel safety	Yes	Yes	Yes	Not applicable
Respond to all reported losses or threats	Yes	Yes	Some	No
Respond to requests for assistance in a timely manner	Yes	Most, but not all	Some	No
Resolve predator damage problems	Yes	Most, but not all	Some	No
Address predator risks to human and pet health and safety	Yes	Yes	Some	No
Address predator damage and threats to agriculture	Yes	Most, but not all	Some	No
Address predator damage and threats to natural resources	Yes	Most, but not all	Some	No
Reduce risk of wildlife strike hazards to aircraft	Yes	Yes	Some	No
Prevent predator damage when feasible	Yes	No	No	No
Minimize nontarget take	Yes	Yes	Most, but not all	No

As such, WS-Wyoming 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 1997).

Additionally, by restricting corrective PDM to the immediate vicinity of predation losses, WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming Provides Technical Assistance Only

Under Alternative 3, WS-Wyoming would be able to provide for the safety of personnel. The number of WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming PDM program, WS Specialists routinely inspect killed livestock to determine whether the damage was caused by predators and what predator caused the damage. WS-Wyoming would be extremely limited in its ability to perform this response under Alternative 3. WS-Wyoming 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.

Under this Alternative, WS-Wyoming 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-Wyoming 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-Wyoming 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-Wyoming. 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-Wyoming

Under Alternative 4, WS-Wyoming would be able to provide for the safety of personnel. The number of WS-Wyoming 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-Wyoming 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.

WS-Wyoming 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-Wyoming 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 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-Wyoming. 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-Wyoming 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, grizzly 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-Wyoming PDM program, is the Alternative which best accomplishes the goals and objectives of APHIS-WS and WS-Wyoming. 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-Wyoming 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-Wyoming 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-Wyoming 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

5.1 Responses to Public Comments

We received a total of 47 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).

1. **We received several comments which are categorically outside the scope of the EA. Comments on topics outside the scope of the EA include nonpredator damage management, wolf management, grazing regulations, and other land management decisions.**

This EA covers PDM conducted by WS-Wyoming within the State of Wyoming, as stated in Sections 1.2 and 1.3. 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:

- Wyoming's wildlife managers are corrupt.
- Wildlife damage management of wolves, ravens, beavers, and prairie dogs.
- Opposes grazing on public lands.
- Reintroduction of native species.

2. **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 information, analyses, and determinations in the EA.
- Supports Alternative 1.

3. **Commenters claim that WS-Wyoming must prepare an EIS for this action due to the breadth and scope of the project.**

The claim that the PDM program is designed to have more than insignificant environmental effects is false. The rapid return of local populations to pre-management levels demonstrates that limited, localized actions taken to resolve a particular damage problem have minimal impacts on the target species' population as explained in section 1.16.3 and Chapter 3 of the EA. The determination for the scale of the analysis is addressed in section 1.15.3 of the EA. We disagree that impacts in the EA should be measured at local or regional levels for the reasons discussed in Section 1.15.3 and within the impact analyses for individual target predator populations in Section 3.1. Our analyses of potential impacts on statewide populations in Chapter 3 indicate that this level of analysis of is not warranted, because the proportion of cumulative take contributed by WS-Wyoming is low for all native predators targeted during PDM.

4. **Commenters claim that WS-Wyoming must prepare an EIS because the program may have significant negative effects on public safety 40 C.F.R. § 1508.27(b)(2).**

We disagree with the assertions that human or pet health or safety would be significantly impacted under any alternatives in the EA. Potential impacts to human and pet safety were analyzed in Sections 1.17.4 and 3.4.1.

Non-target take under Alternative 1 was analyzed in Section 3.2.1, which includes any take of pets. WS-Wyoming might use two chemicals for lethal PDM, as discussed in Appendix A: 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. 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, 3.4.1.4, 3.5.1, and 3.6.1.

Literature cited by commenters reference the 2005 killing of two grizzly bears (Keefover-Ring 2009), which incorrectly implies that M-44 devices were the cause of mortality. In actuality, WS-Montana intentionally targeted the two bears with snares. Only at the request of WGFD and USFWS will WS-Wyoming provide operational PDM for grizzly bears in Wyoming.

Alternative 1, including the use of M-44s and Large Gas Cartridges, was determined to result in no significant impacts on any health 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 and Section 2.11.2.2. APHIS personnel who work with M-44s are specially trained and certified to ensure they comply with WS-Directive 2.415 (M-44 Use and Restrictions Updated 2/27/2020) and the 26 EPA Use Restrictions for the devices (Revised April 24, 2017). The updated WS M-44 use policies and restrictions further reduce the risk to public safety, pets, nontarget species, and the environment. APHIS Wildlife Services understands the public's concern regarding the use of M-44s and is committed to the safe and responsible use of these devices.

5. **Commenters claim that WS-Wyoming must prepare an EIS because the program affects specially protected areas to which the action may establish precedent for future actions with significant environmental effects 40 C.F.R. § 1508.27(b)(6).**

We disagree with the claim that PDM activities on Wilderness Areas and Wilderness Study areas will result in significant environmental effects or establish precedent for future actions with significant environmental effects. Unlike in *WWP v. APHIS-WS* (320 F. Supp. 3d), WS-Wyoming sufficiently addressed other agencies concerns in preparation of this EA. WS-Wyoming also maintains consistency with agency land management plans (Section 1.14) and thoroughly considers impacts of PDM activities in special management areas (Sections 2.10.24 and 3.5.1.4). WS-Wyoming abides by all federal and state laws, regulations, and policies set forth for special management areas as stated in Section 1.16.5 and Appendix C.

6. **Commenters claim that WS-Wyoming must prepare an EIS because the proposal is highly controversial and involves uncertain effects and unknown risks 40 C.F.R. § 1508.27(b)(4).**

We disagree that the PDM program is controversial and that an EIS is required due to unknown risks. We included consideration of 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. Our analyses in Chapter 3 demonstrate that Alternative 1 would not significantly impact the environment. The failure of any particular organization or person to agree with every act of a federal agency does not create controversy regarding effects. Dissenting or oppositional public opinion, rather than concerns expressed by agencies with jurisdiction by law or expertise and/or substantial doubts raised about an agency's methodology and data, is not enough to make an action "controversial" and is addressed in Section 2.3.6. Direct comparisons of this EA to *Wildlands v. Woodruff* (151 F. Supp. 3d 1153, 1165 [W.D. Wash 2015]) and *WWP v. APHIS-WS* (320 F. Supp. 3d) are not appropriate. WS in these cases did not take a hard look at significant issues regarding the effectiveness of PDM, dismissed comments from other agencies, and failed to detail PDM methods that coincided with the scope of the EA. In this EA, WS-Wyoming provides reasoned analyses of the effectiveness of PDM in Section 1.18 and addresses the scope of the EA in Section 1.15. WS-Wyoming also consults extensively with state and federal agencies to ensure consistency with their land management plans, which is explained in Sections 1.12, 1.13, and 1.14.

7. **Commenters claim that WS-Wyoming must prepare an EIS because the program is likely to have cumulatively significant environmental effects 40 C.F.R. § 1508.27(b)(7).**

We disagree with the claim that the EA fails to take a "hard look" at significant cumulative impacts of PDM to predator populations and ecosystems. WS-Wyoming believes that the EA provides an adequate cumulative impact analysis that considers private individual take and compensatory reproduction effects in Chapter 3 and Section 2.3.2 of the EA. Other wildlife damage management actions involving wolves, non-predator mammals, and birds conducted by WS-Wyoming are covered under other NEPA documents. We disagree that removal of these species from this analysis is improper segmentation as this EA is for PDM actions only.

8. **Commenters claim that WS-Wyoming must prepare an EIS because the program is likely to adversely affect ESA listed species or its habitat 40 C.F.R. § 1508.27(b)(7) or may result in incidental take of ESA listed species 40 C.F.R. § 1508.27(b)(10).**

We disagree that PDM program is likely to adversely affect ESA listed species or its habitat. The effects of the WS-Wyoming PDM program on sensitive and nontarget wildlife, including ESA listed species, is adequately analyzed for each alternative in Chapter 3 of the EA. 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. WS-Wyoming takes many precautions to minimize the likelihood of taking non-target animals, including threatened or endangered species, including: (1) WS-Wyoming employs a variety of protective measures, as discussed in Section 2.11; (2) WS-Wyoming consults with the USFWS, as discussed in Section 3.2.1.1 in order to minimize the likelihood of impact to any threatened or endangered species; (3) WS-Wyoming 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-Wyoming works with state and federal land managers, as discussed in Section 1.14, 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-Wyoming works with WGFD, as discussed in Section 1.13 to ensure that state-listed species are protected; and (6) WS-Wyoming follows federal, state, and local laws, including those intended to protect listed species. WS-Wyoming PDM will have no effect on any ESA listed fish and amphibian species because PDM methods will not affect water or wetlands as stated in Sections 2.11.2.3 and 3.2.1.1. 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, 3.6.1, and 3.71); thus, an EIS is neither warranted nor required.

As noted in Section 3.2, WS-Wyoming unintentional take of nontarget species is extremely low relative to known species population size and range and does not contribute substantially to cumulative impacts from other WS-Wyoming wildlife damage management activities or other known sources of mortality such as licensed hunting and trapping (Section 3.2.1 and Table 3-16).

9. **Commenters claim that the EA fails to justify a purpose and need for the proposed action.**

We disagree with this claim. The purpose of the EA, and the goals and objective of APHIS-WS and WS-Wyoming are discussed in detail in Sections 1.2, 1.9, 1.11.2, and 1.17.

10. **Commenters claim that the EA lacks adequate baseline data to support a credible analysis of environmental effects to local ecosystems and local predator populations.**

We disagree with this claim. A full discussion of the environmental baseline used by WS-Wyoming to evaluate significant impacts can be found in Section 1.16.4.

11. **Commenters claim that public attitudes have shifted dramatically in recent times and that killing native wildlife – a public trust resource – especially on publicly owned lands, for the perceived economic benefit of a handful of private livestock producers, fails the government's public trust obligations (Treves et al 2017).**

Treves et al. (2017) discuss the public trust principle, that democratic governments must preserve environmental components (e.g., predators) as assets held in trust for current and future generations. The authors identify what they perceive as challenges to meeting public trust responsibilities as they pertain to predators including challenges to agency good-faith action as a trustee for all uses and values of predators instead of advocacy for a particular perspective (e.g., agency capture). Other challenges identified include discussion of the limits of current information on predator biology including information on sustainable harvest, and the efficacy of access to lethal methods in changing public attitudes towards predators. Treves et al. (2017) recommend the establishment of neutral trustees who take a broad public interest approach to allocating environmental assets for current and future generations. Decisions regarding management of public trust resources would be guided by science. Many of the issues addressed by (Treves et al. 2017) are outside the scope of this EA (e.g., appointment of public trustees for natural resources, the role of agencies, courts and regulations in framing predator management policy). Other issues, such as the role of lethal methods for predator management in changing public attitudes are addressed herein.

As stated in Section 1.19.6.1, because wildlife belong to the American public, it is national policy that some of the resolution of damage caused by those same species is also publicly supported. Within the constraints of WS-Wyoming decision-making, we believe that the proposed EA works in good faith to preserve predator populations and their role in ecosystems for current and future generations. WS-Wyoming also consults extensively with state and federal agencies to ensure consistency with their land management plans, which is explained in Sections 1.12, 1.13, and 1.14. WS-Wyoming monitoring of program actions will help to ensure that new information on predator biology, the role of predators in ecosystems, efficacy of nonlethal and lethal PDM methods, and the human dimensions of predator management are considered and included in program decision-making, as appropriate.

12. **A commenter claims that according to Friends of Animals v. Clay, No. 13-cv-7293(JG), 2014 WL 4966122, at n. 4 (E.D.N.Y. Oct. 3, 2014), to act within its statutory mandate under the**

ADCA, Wildlife Services must make a finding that the species intended to be targeted are "injurious." They further claim that WS-Wyoming has not established that the predators to be targeted by its activities are injurious and that Wildlife Services is not authorized to kill predators to subsidize prey populations to support sport hunting.

Friends of Animals v. Clay concluded that WS met all legal requirements under NEPA and the Migratory Bird Treaty Act in the lethal taking of birds at JFK airport. The full account cited by the commenter states:

> "*I also reject FoA's argument that more specific information was required in order to show that the revised BHRP was within APHIS's legal power. The statutory grant of authority is broad, and permits the agency to "conduct a program of wildlife services with respect to injurious animal species and take any action the Secretary considers necessary in conducting the program." 7 U.S.C. § [8351]. The SEIS adequately describes how the bird species in question are "injurious," since even small birds can present a risk to aircraft, and large ones present a major risk.*"

We disagree with the claim that this EA fails to establish that predators targeted by PDM are "injurious". A full discussion of the need for PDM can be found in Sections 1.2 and 1.17. The appropriateness of manipulating wildlife for the benefit of another wildlife species is discussed in Section 2.3.1. To achieve its management objectives, WGFD, USFWS, and tribes can request WS assistance. WS would not conduct PDM for wildlife protection without such management authority.

13. **Commenters claim that the EA fails to consider that coyote populations are self-regulating.**

Commenters did not provide literature to support this claim and WS is unaware of any data that demonstrate that self-regulation of coyote meets WS objectives (*e.g*., the self-regulation of coyote lower the risk to livestock). We disagree with the claim that the EA fails to adequately consider coyote behavior and family group structure in response to PDM activities. Impacts of PDM specifically on coyote populations is discussed in Sections 1.17.4.2 and 3.1.1.1.

14. **Commenters claim that WS-Wyoming provides flawed alternative assessments by assuming that lethal PDM is still necessary in each alternative.**

A full discussion of the need for both nonlethal and lethal PDM can be found in Sections 1.2 and 1.17. The data presented show that many Wyoming predator species affect livestock, property, humans, pets, and natural resources. An alternative of using only nonlethal direct assistance is discussed in Section 2.10.3 but was not considered in detail due to the nearly identical outcomes to Alternative 3. WS-Wyoming has no authority to regulate hunting laws and private individuals can lethally take state classified predatory animals in Wyoming (coyote, jackrabbit, porcupine, raccoon, red fox, skunk or stray cat [W.S. § 23-1-101]) at any time without a permit. The WDA informed WS-Wyoming there were 77 aircraft in Wyoming registered to conduct aerial shooting as of February 1, 2019 (K. Hart, WDA, pers. Comm. 2019). This does not include the five aircraft used by WS-Wyoming. In 2018, there were permits for aerial shooting of predators issued to 32 private pilots and 95 aerial shooters in Wyoming. The difference in the number of registered pilots and registered aircraft is because licensed pilots may register multiple aircraft. Due to the need described in the EA and the current take of predators by private individuals, there is no reason to believe that lethal PDM would cease in Wyoming just because WS-Wyoming discontinues the service. As such, a cumulative analysis of the impact of WS-Wyoming PDM includes the assumption that lethal PDM occurs in all alternatives, whether or not it is due to WS-Wyoming direct assistance.

15. **Commenters claim that WS-Wyoming uses outdated literature and selects science that support biased opinions.**

We disagree with the assertions that WS-Wyoming did not use the best available science in the EA, used outdated science, ignored dissenting scientific documents and opinions, or 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. 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.

16. **Commenters claim that WS-Wyoming failed to take a hard look at the ecological impacts of removing carnivores.**

We agree that carnivores such as coyotes and mountain lions play critical roles in ecosystems and that the extirpation of these species can result in negative impacts. We disagree that WS-Wyoming failed to take a "hard look" look at the ecological impacts. WS-Wyoming did take a "hard look" at the actions outlined in each of the alternatives and made reasoned decisions based on the analysis contained in the EA**.**

We disagree with the claim that WS-Wyoming ignores the trophic cascade effects of predator control or the localized impacts of predator removal. Impacts of PDM on biodiversity and trophic cascade is discussed in Section 3.3. Many of the studies cited by commenters evaluate dramatic and long-term population reductions or complete eradiation of species, which is not analogous to WS-Wyoming PDM. The NEPA process does not require WS-Wyoming to settle disputes regarding opposing opinions or disagreements among researchers. Ripple et al (2014) and Ripple et al (2010) examined changes in landscape after the reintroduction of species after decades long extirpation. Callan et al (2013) compared wolf occupied areas in Wisconsin with low rates ranging from 0 to 3 years occupied. Crooks and Soule (1999) analyzed urban landscapes devoid of historically present coyotes. Estes et al. (2001) and Prugh et al (2009) discusses the impacts of historic extirpation of species from around the world, such as the 1960s eradication of rinderpest in the Serengeti. Henke and Bryant (1999) observed trophic cascade impacts only after they removed half of the coyote population from the landscape. WS-Wyoming does not eliminate entire populations from the landscape; therefore, these studies are not applicable to this EA. As stated in Section 3.1.1.1, WS-Wyoming PDM activities will not significantly impact the coyote population.

17. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the effectiveness of PDM and that PDM can increase livestock losses.**

We disagree with the assertion that lethal PMD results in more livestock depredation and higher losses, as discussed in Section 1.17.5. 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 1.17.5.4. These documents were not included in the EA because they did not add substantively to the information or analyses provided.

18. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the effectiveness of non-lethal PDM.**

We agree that non-lethal PDM methods can be effective in some circumstances. As stated in Section 2.10.6 and throughout the EA, nonlethal methods are given priority by WS-Wyoming field specialists when addressing requests for assistance, when applicable and effective (WS Directive 2.101). A use of only non-lethal direct assistance alternative is discussed in Section 2.10.3.

19. **Commenters claim that WS-Wyoming failed to consider nine articles that show that there is better evidence for functional effectiveness in preventing livestock losses from nonlethal methods than from lethal methods.**

We disagree with the assertion that the information presented by Treves et al. (2016), Treves et al (2019), and van Eeden et al (Sept 2018) represents the best available science for the reasons discussed in Section 1.18.3 and Appendix B. Eklund et al (2017), Khorozyan and Waltert (2020), Lennox et al (2018), Miller et al (2016), Moreira-Arce et al (2018, and van Eeden et al (Jan 2018) review previously published literature on wildlife damage management. The authors of these articles found that both lethal and nonlethal methods can be effective or ineffective, depending on environmental conditions, the predator species targeted for management, and the long-term goals of the management action. These articles do 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. In most instances, WS-Wyoming PDM actions only needs to be applied for a short time frame such as during the calving or lambing season. The need to repeat or continually implement a PDM method is not necessarily an indicator that the method is ineffective. Very few methods, nonlethal or lethal, provide permanent resolution of wildlife conflicts without ongoing effort. Just as lethal methods may need to be periodically repeated on the same property, nonlethal methods such as herding, livestock guarding animals, and frightening devices require sustained effort to implement for effective damage reduction, yet these methods are commonly perceived to be effective. WS-Wyoming responds to individual depredation events to assist in resolving those conflicts, then addresses the next conflict as requested and funded. Given the analysis in Chapter 3 of the EA that indicates predator populations quickly recover from removals by WS-Wyoming, this approach does not guarantee predation events will not recur at some later point. WS does provide technical assistance on methods that make it less likely for predation to reoccur (e.g., fencing, habitat management, carcass disposal, livestock husbandry practices, livestock guarding animals) where applicable.

20. **Commenters note that BMPs for skunks do not include foothold traps.**

Thank you for bringing this to our attention. WS recognizes the value of BMP guidelines and, per WS Directive 2.450, WS-Wyoming follows BMPs to the greatest extent possible. WS-Wyoming is in compliance with all federal, state, and local trapping laws and regulations. The EA has been edited to more accurately describe WS-Wyoming trapping methods regarding BMPs.

21. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the ethics of PDM.**

We disagree with the claim. We discussed and analyzed this topic in Sections 1.6, 1.11.3, 2.2.6.1, 2.2.6.2, 2.3.7, 2.11.2.8, and 3.6.

22. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the humanness of aerial PDM.**

We disagree with the claim. Discussion of aerial PDM actions, and the impacts on target species, nontarget species, public lands, and human and pet safety are in Sections 1.14.4, 1.17.4.7, 2.6.6, 2.11.2.4, 3.2.1.4, 3.2.1.5, 3.2.1.6, 3.2.1.8, 3.4.1.1, 3.4.1.2, and 3.5.1.3. Commenters cite Pepper et al (2003) as evidence that PDM aerial activities will have significant impact on wildlife populations. However, Pepper et al (2003) reviews the impacts of jet aircrafts which create substantially more noise than WS-Wyoming fixed-wing aircraft and helicopters. We disagree with the assertion that the EA uses species-specific studies of aerial noise that should not be applied to coyotes. For full analysis on the impact of noise due to WS-Wyoming aerial PDM see Section 3.2.1.5 and 3.2.1.6.

23. Commenters claim that WS-Wyoming failed to take the requisite hard look at the humanness of PDM and the impacts on pet and human safety.

We disagree with the claim that the EA fails to take a hard look at the humanness of PDM. As discussed in Section 3.6.1.1, WS-Wyoming understands that PDM may not be acceptable to some individuals based on their values and/or beliefs. Humaneness and ethics are discussed in Sections 1.6, 1.11.3, 2.2.6.1, 2.2.6.2, 2.3.7, 2.11.2.8, and 3.6.; humaneness and ethics issues under Alternative 1 are discussed in Section 3.6.1.1. The protective measures implemented by WS-Wyoming, as discussed in Section 2.11, and the descriptions of methods provided in Appendix A, provide further information on the humaneness of WS-Wyoming implementation of PDM. Selectivity of the various methods also relates to humaneness. More selective methods are considered more humane methods, because they reduce unnecessary pain and suffering in non-target animals. As discussed throughout the EA, WS-Wyoming uses the most humane and selective methods practical for each predator damage situation.

24. Commenters assert that the EA must disclose or evaluate the potential impacts of a sub-lethal dose of carbon monoxide to target or non-target species in the event a device is not set correctly or malfunctions.

Large Gas Cartridges are hand-placed and ignited by a WS personnel on site, ensuring that a sub-lethal dose of carbon monoxide is unlikely. Large Gas Cartridges are used in underground burrows in outdoor settings; this severely limits the potential for exposure of humans or non-target animals. 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. 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.

25. Commenters oppose the use of M-44s and Large Gas Cartridges due to the poisonous chemicals they contain.

We understand that some individuals will disagree with some PDM methods. Section 2.11 provides the protective measures used by WS-Wyoming to minimize the likelihood of non-target take or human exposure. These methods are discussed in Appendix A.

26. Commenters claim that WS-Wyoming check times for foothold traps are unethical.

WS-Wyoming disagrees with this claim. 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. Per WGFD regulations, WS-Wyoming checks foothold traps every 72 hours and snares and body grip traps at least once a week (W.S. § 23.2.303). WS-Wyoming follows state law and regulations regarding the setting and checking of traps and snares as follows per APHIS-WS Directive

2.450 and 2.210 and Trapping Best Management Practices (BMPs) which are based on scientific evaluations of humaneness, efficiency, selectivity, practicality, and safety.

27. **Commenters claim that traps and snares are indiscriminate and inhumane.**

We disagree with this claim. WS-Wyoming might use several types of traps for PDM actions, as stated in Appendix A. 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. Protective measures for the use of traps and snares by WS-Wyoming are included in Section 2.11. 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. This process is discussed in the EA at Section 3.6.1.

28. **Commenters assert that WS-Wyoming must disclose all data regarding the number of target and nontarget animals killed using Large Gas Cartridges during denning operations.**

We agree with this comment and WS already provides this detailed information for public review. Program Data Reports are available on the USDA APHIS website and can be accessed by the following link: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_reports/sa_pdrs.

29. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the impacts on nontarget species.**

We disagree with the claim that the EA's assessment of the impacts on nontarget species and ESA listed species and conclusions of our analyses is inadequate or incorrect. The potential for impacts on nontarget species was discussed and analyzed extensively in Section 3.2. Our analysis determined that PDM activities conducted by WS-Wyoming would not result in any significant impacts to nontarget species populations, including ESA listed species.

30. **Commenters claim that the EA's description of suitable habitat for ESA listed species is inaccurate or insufficient.**

We understand that some individuals believe the loss of a single animal may cause irreparable harm to the population. Although an individual predator or multiple predators in a specific area may be killed by WS-Wyoming PDM activities, this does not in any way irreparably harm the continued existence of these species. Our analysis in Chapter 3 shows that the species WS-Wyoming takes in PDM actions are expected to sustain viable populations. As stated in Section 1.14.3, WS-Wyoming consults with USFWS to ensure the PDM program will not jeopardize the continued existence of ESA listed species. Managing wildlife populations in Wyoming is under the legal jurisdiction of WGFD, USFWS, and tribal agencies. WS-Wyoming defers to these entities and any wildlife population management decisions are outside the scope of WS authority. Biological Opinions from the USFWS concluded that it was possible for WS-Wyoming wildlife damage management actions (all actions combined) to result in the incidental take of grizzly bears and Canada lynx. The USFWS determined that the potential incidental take would not result in jeopardy to the grizzly bear population when considered individually and in context of all other impacts on the species populations. Section 7 consultations with the USFWS help identify risks to listed species but they also help agencies identify measures which may be implemented to reduce risks. WS Section 7 consultations referenced in the EA address all WS-Wyoming wildlife damage management activities including PDM and, as such, represent cumulative impacts on the population.

WS-Wyoming takes many precautions to minimize the likelihood of taking non-target animals, including threatened or endangered species, including: (1) WS-Wyoming employs a variety of protective measures, as discussed in Section 2.11; (2) WS-Wyoming consults with the USFWS, as discussed in Section 3.2.1.1 in order to minimize the likelihood of impact to any threatened or endangered species; (3) WS-Wyoming 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-Wyoming works with state and federal land managers, as discussed in Section 1.14, 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-Wyoming works with WGFD, as discussed in Section 1.13 to ensure that state-listed species are protected; and (6) WS-Wyoming follows federal, state, and local laws, including those intended to protect listed species.

31. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the impacts of PDM on recreation.**

We disagree with the claim that the EA fails to provide a detailed analysis of the impact PDM activities have on recreation. The killing of four wolves in August 2020 referred to by commenters was in response to WGFD request for wildlife damage management due to depredations on private and public lands over the course of the past year. Removal of these particular wolves was determined to be the appropriate method to reduce conflict and aid in WGFD's management goal to maintain about 160 wolves in the trophy-game area. The EA addresses many sociocultural aspects and potential impacts such as aesthetics, impacts to recreation, and the value of wildlife in Sections 1.6, 1.19.4, 2.2.6.2, and 2.4.

32. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the cost-benefits of WS-Wyoming's PDM activities.**

The assertion that the EA in in violation of NEPA because it does not include a cost-benefit analysis is false. NEPA does not require agencies to conduct an economic analysis or disclose financial information in EAs. This issue has been addressed in detail in Section 1.19. Based on a thorough review of the issue, WS has determined that a detailed economic analysis is not required by CEQ; and that there are important qualitative values relevant and important to its decision-making that cannot be readily monetized. These values include recreational, aesthetic, safety, ecological and spiritual benefits. For these reasons, WS-Wyoming has determined that a formal cost-benefit analysis would not contribute substantively to WS' decision making at this time and has decided to address these issues qualitatively.

33. **Commenters claim that WS-Wyoming failed to take the requisite hard look at the effects analysis on the site-specific environmental impacts.**

We disagree that impacts in the EA should be measured at local or regional levels for the reasons discussed in Section 1.15.3 and within the impact analyses for individual target predator populations in Section 3.1. The determination for the scale of the analysis is addressed section 1.15.3 of the EA. The rapid return of local populations to pre-management levels demonstrates that limited, localized actions taken to resolve a particular damage problem have minimal impacts on the target species' population as explained in section 1.16.3 and Chapter 3 of the EA. Our analyses of potential impacts on statewide populations in Chapter 3 indicate that this level of analysis is not warranted, because the proportion of cumulative take contributed by WS-Wyoming is low for all native predators targeted during PDM.

34. **Commenters claim that WS-Wyoming failed to take the requisite hard look at other US state agencies stance on PDM.**

WS-Wyoming addresses the wildlife management damage issues for the State of Wyoming because most mammal species are managed at the state level. This includes the establishment of harvest limits and regulations pertaining to damage management. Management decisions made for each WS state program are made independently, based on: (1) state-specific information on wildlife populations and ecosystems, (2) state-specific land use patterns, (3) state, local, and tribal regulations and policies, (4) state-specific wildlife management plans and objectives, and, (5) other state-specific and local factors, including the types of PDM services requested and authorized by state, county, and local management entities. Consequently, other US state agencies may inform WS-Wyoming programs, but ultimately, the analysis of the EA is not national or regional in scope and must address state-specific needs.

35. **Commenters question the accuracy of recordkeeping by WS-Wyoming and claim WS-Wyoming should provide more detailed reporting.**

As stated in Sections 1.11.2, 1.11.3, and 2.3.10, WS-Wyoming personnel follow WS Code of Ethics (Directive 1.301), accurately report field activities (WS Directive 4.205), and follow all federal, state, and local laws and regulations. Accurate reporting is necessary to meet WS-Wyoming's mission of professionally supporting the coexistence of humans and wildlife, as well as, WS-Wyoming's objective to comply with other agencies wildlife management goals. Data on the WS Program, including information by state, equipment used, nontarget take, and funding sources, is already available and can be accessed on the USDA APHIS website: https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_reports/sa_pdrs. Locations of where operations occur on the county level are provided in Figure 1-1 Section 1.13 of the EA.

The claim that the EA fails to acknowledge the OIG Audit Report 33601-0002-41 is false. Commenters incorrectly refer to the 2018 Final Action for Verification of Audit Report 33601-0002-41 as a recent audit that was ignored by this EA. A detailed discussion of the OIG Audit Report 33601-0002-41 is in Section 1.18.2.1 of the EA. Further discussion of WS accountability reports is detailed in Section 1.18.2.2 of the EA.

36. **Commenters claim that WS-Wyoming fails to consider the alternative that livestock losses should be an accepted cost of doing business.**

We disagree with the claim that the EA does not adequately consider that livestock losses should be an accepted cost of doing business. This comment is addressed in Section 2.10.1 of the EA.

We disagree with the claim that the current program of providing lethal control for free incentivizes ranchers to not take actions to prevent predation and that ranchers may allow livestock to get killed on purpose in order to have carnivores killed. The WS-Wyoming PDM program is not "free" to livestock producers. Producers contribute to the cost of the program via brand inspection fees on the sale of livestock. WS-Wyoming does not rely solely on unverified losses to justify the need for PDM action as explained in Section 2.6.3 of the EA. As stated in Section 2.10.2, the WS-Wyoming program currently requests cooperative local government or private funding to cover between 60 and near 100% of the program's costs for services. WS does not believe a reasonable producer would work to induce predation on livestock in a situation where no predation is occurring just to trigger lethal PDM. Such activity defies reason, is economically unjustified, and would be a poor business practice. WS-Wyoming is not aware of any producers who avoid taking predation action or allow animals to be killed in order to trigger lethal PDM.

37. **Commenters claim that the EA refers to cost-effectiveness to not consider the use of only non-lethal direct assistance in detail.**

The assertion that the EA does not adequately consider use of only non-lethal direct assistance because "it would not be cost-effective" is false. Cost-effectiveness is not used as justification to not consider this alternative in detail. This comment is addressed in Section 2.10.3 of the EA.

38. Commenters claim that WS-Wyoming failed to take a hard look at the impacts of lead ammunition use on the environment and nontarget species.

We disagree with the claim that this EA improperly downplays the risks associated with adding lead to the environment through the use of lead ammunition. We used the best available science and information to conduct our analysis and determined that the use of lead ammunition by WS-Wyoming would not result in a significant impact on the environment for the reasons discussed in Sections 2.10.14, 3.2.1.2, 3.2.1.3, and 3.4.1.3. In compliance with Federal and State regulations, WS-Wyoming uses non-lead ammunition when conducting wildlife damage management under Migratory Bird Treaty Act permitted activities and in certain protected areas (*e.g*., wetlands, USFWS refuges, and USNPS lands).

Commenters partially cite a statement given by USFWS during the opening summary *judgement* brief of *Western Watersheds Project v. USDA WS 2018*. Indeed, USFWS state that lead has been attributed as the cause of death in eagles and other scavenging birds, but USFWS also recommend that to minimize impacts to nontarget wildlife, WS must make:

"1) A commitment to make every effort practical to recover and/or properly dispose of all animals shot with lead ammunition, regardless of animal size, and, if this is not possible, to use non-toxic ammunition, OR 2) a commitment [sic] to phase-out the use of any lead ammunition and phase-in the use of non-toxic shot in areas for all WS activities".

All carcass disposal is consistent with APHIS-WS Directives 2.5.10 and 2.515. Moreover, WS is working to shift to lead-free ammunition as new lead-free alternative that meet WS standards for safety, performance, and humaneness are developed and become available in adequate quantities for program use (Section 3.2.1.3 of the EA). Thus, WS-Wyoming continually works to decrease the risk of lead exposure to the environment and nontarget animals.

From 2011 to 2015, APHIS-WS added an estimated average of 67 mg lead/acre for wildlife damage management activities annually (USDA-APHIS-WS Lead Risk Assessment 2017; currently under peer-review). Data show that U.S. use of lead from ammunition, shot and bullets, was 69,200 metric tons (USGS 2008, 2011). Average lead use in WS programs is approximately 5.0 metric tons per year. The amount of lead released into the environment from WS activities is less than 0.01% than the estimates for lead in ammunition and fishing sinkers. Average lead use for WS-Wyoming activities was an estimated 996.3 pounds of lead annually from 2011 to 2015. The contribution of lead to the environment from WS-Wyoming is negligible and, therefore, an incrementally negligible addition to the cumulative effects from all sources of lead in the environment.

39. Commenters claim that WS-Wyoming failed to consider several studies on the impacts of lead on animal species.

Many studies cited by commenters – some experiments in a controlled setting (Fisher et al 2006; Hoffman et al 1981) and others samples of wild populations (Gangoso et al 2009; Kennedy et al 1979; Lewis et al 2001; Yaw et al 2017) – demonstrate that lead poisoning can lead to negative effects and death in individual birds. Other studies citied show that birds will consume lead ammunition in the wild (Franson et al 2009; Kendal & Scanlon 1979). In Section 3.2.1.3, the EA acknowledges that lead poisoning can have detrimental effects on birds and that lead ammunition by WS-Wyoming may have the potential to adversely impact individual nontarget animals. However, as discussed in Chapter 3 of the EA, PDM actions taken to resolve a particular damage problem have minimal impacts on the species' population.

Pattee et al (1981) is referenced and addressed in Section 3.2.1.2 of the EA.

Miller et al (2001) found that eagles that consumed lead did not have differing hematological values or nutritional conditions from the healthy eagles. Keel et al (2002) found that there was a low potential for lead poisoning compared to lead deposition due to hunting. Kendal et al (1995) conducted an ecological risk assessment on the impact of lead shot exposure in upland birds but was not able to clearly define a significant risk. These studies were not included in the EA because they do not add substantially to the analysis.

Many studies cited by commenters suggest that lead concentration in scavenging birds and mammals is likely attributed to hunter discarded viscera of game animals (Bedrosian & Craighead 2009; Church et al 2006; Craighead & Bedrosian 2009; Cruz-Martinez et al 2012; Ecke et al 2017; Hunt et al 2006; Neumann 2009; Rogers et al 2009). Kramer and Redig (1997) indirectly support this conclusion as authors found that lead consumption was not correlated to eagles feeding on water fowl. These studies support the conclusion made in Section 3.2.1.2 of the EA but we cited other references which contained similar information. WS-Wyoming makes every effort to recover animals killed during PDM activities when practical (WS Directive 2.515, Disposal of Wildlife Carcasses). WS-Wyoming personnel can dispose of carcasses by field burial or burning, landfill burial, or donation (refer to WS Directive 2.510 Fur, Other Animal Parts, and Edible Meat for guidelines on donation).

40. **Commenters claim that WS-Wyoming fails to consider the alternative that WS-Wyoming should be prohibited from operating on federal lands.**

We disagree with the claim that the EA dismisses the alternative that WS-Wyoming is prohibited from operating on federal lands. We further disagree with the claim that the reliance on MOUs and Annual Work Plans are insufficient to comply with NEPA's requirements. 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) and other public lands. We considered an alternative to not conduct PDM in WAs or WSAs in Section 2.10.24 and public lands in Section 2.10.23. These alternatives were not considered in detail for the reasons provided therein. We disagree that the inclusion of site-specific analyses for all SMAs in Wyoming would be reasonable. Due to the infrequent and sporadic nature of WS-Wyoming's PDM work in SMAs, analyses for each SMA in Wyoming would be uninformative.

41. **Commenters claim that the EA fails to show that WS-Wyoming PDM efforts do not lead to higher livestock losses and the scattering of predators around the landscape after breaking up social networks with lethal control methods.**

We disagree with these assertions. These issues are addressed in Sections 2.3.2., 3.1.1., 3.2.1, and 3.3.

42. **Commenters claim that the EA fails to consider the true costs of the PDM program because it does not adequately address the positive value of predators.**

We disagree with this statement. The value of predators for aesthetic, recreational, emotional, psychological, and economic reasons is discussed extensively throughout the EA.

43. **Commenters claim that predators should not be managed to benefit other wildlife species or for recreation.**

We understand that some individuals feel it is not appropriate to manipulate one wildlife species for the benefit of another wildlife species, or for the benefit of hunters or recreation and this topic is addressed in Section 2.3.1 of the EA. This is a matter of individual perception and perspective. The jurisdiction for managing most resident wildlife in the state rests with WGFD which, under state law, can request WS assistance in achieving its management objectives. 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.

44. **Some commenters requested a comment period extension.**

A thirty-day comment period is required by CEQ regulations § 1501.6 (a)(2) under the National Environmental Policy Act of 1969. Several commenters requested an extension of the comment period including plaintiffs on a lawsuit settled on August 8, 2019. This settlement required WS to complete its EA and issue a Decision by January 8, 2021. This timeline precludes consideration of an extended public comment period. Ample notice of the public comment period for this EA was provided via GovDelivery, The Wyoming Tribune Eagle, and others, per CEQ regulations.

45. **Some commenters are opposed to WS programs or prefer Alternative 4.**

WS-Wyoming recognizes that some individuals will oppose any degree of WS-Wyoming predator damage management. A full discussion of the need for PDM can be found in Sections 1.2 and 1.17. APHIS-WS provides federal professional leadership and expertise to meet this need and resolve wildlife conflicts to help create a balance that allows people and wildlife to coexist. Our analyses in Chapter 3 of the EA show that Alternatives 1, 2, 3, and 4 will not result in any significant impacts on the environment.

46. **Some commenters provided literature for consideration.**

WS-Wyoming reviewed and considered all the literature that was provided by the commenters. Some of the literature included was already cited in the EA, to the extent that they were new to WS-Wyoming, if they did not add anything to the analyses in the EA, then WS-Wyoming did not cite them. Other literature that was provided and not cited in the EA were opinion articles and articles that were outside of the scope of the EA.

5.2 Documents Incorporated and Cited in the EA.

We received documents attached to various comments that were already incorporated into the EA and cited herein. These include:

Allen et al. 1987

Bedrosian et al. 2012

Beschta and Ripple 2006

Bergstrom et al. 2014

Cooley et al 2009

Crooks and Soule 1999

Estes et al. 2011

Kauffman et al. 2010

Jaeger 2004

Knowlton et al. 1999

Miller et al. 2012

Pattee et al. 1981

Peebles et al. 2013

Prugh et al. 2009

Ripple and Beschta 2006a

Ripple and Beschta 2007

Ripple and Beschta 2012

Ripple et al. 2013

Sacks et al. 1999

USDA 2019, sodium cyanide in WDM

USDA 2019, carbon monoxide in WDM

Waser et al. 2014

WGFD 2008, annual report

WGFD 2018, management annual report

WDFD 2019, wolf management report

5.3 Documents Considered but Not Cited in the EA.

We received documents attached to comments that were previously considered during the preparation of the EA. The following were not cited because they do not add substantively to the information and analyses in the EA.

AFWA BMPs Striped Skunks

Bergstrom 2017, carnivore conservation

Bouchard et al. 2013

Bradley et al. 2015, wolf removal

Brand and Nel 1997, avoidance of cyanide guns by black backed jackal

Brand et al. 1995, regular removal of black backed jackals

Brown et al. 1999

Browne-Nunez et al. 2015, tolerance of wolves

Bruskotter and Wilson 2014

Cart 2014, newspaper, congressmen question costs of mission of WS

Carter et al. 2019

Cooley et al. 2009, hunted cougar population regulation

Creel and Christianson 2009

Fedy and Aldridge 2011

Fedy et al. 2014, habitat prioritization

Flagel et al. 2015, trophic cascade

Fortin et al. 2005

Frey et al. 2003, predator control on ring-necked pheasant

Friend 1999, lead exposure

Gehring 2011, good fences make good neighbors

Giampiero et al. 2019, climate change and livestock

Goncharov et al. 2006, effects of fluoroacetate

Halofsky and Ripple 2008a

Halofsky and Ripple 2008b

Hawk Watch Inc. 2011, golden eagle survey

Hebblewhite et al. 2005

Hollenbeck and Ripple 2008

Hooke et al. 2006, clinical signs of cyanide toxicosis

Husseman 2002, prey selection

Husseman et al. 2003, prey selection

IDNR, bald eagle and lead poisoning

Imbert et al. 2016, wolf diet

Iossa et al. 2007, animal welfare mammal trapping

Kerley et al. 2018, predator management in South Africa

Kimble et al. 2011

Kompaniyets and Evens 2017, wolf management

Laundre et al. 2001

Liebezeit et al. 2014, blood lead levels

Manfredo et al. 2009, wildlife values

Manning et al. 2009

Mao et al. 2005

Marshal 2015, human injures in snares

Mattson et al. 1991, grizzly bear food habits

Maughan 2010, wolf management

Middletone et al. 2013

Musiani et al. 2005, wolf depredation

O'Neill et al. 2007, monitoring foothold traps with mobile phone

Painter et al. 2012, trophic cascade

Painter et al. 2015

Pattee et al. 1990

Pepper et al. 2003, effects of aircraft noise on wildlife

Poudyal et al. 2016, wolf depredation

Proulx and Barrett 1994, ethical concerns of traps

Proulx et al. 2015, humaneness of snares

Ramp and Beckoff 2015, ethics

Ripple and Beschta 2003

Ripple and Beschta 2004

Ripple and Beschta 2005

Russell 2014, newspaper, M-44 dog death

Ruth 2014, deer harvest

Rutledge et al. 2010

Santiago-Avila et al. 2018, wolf management

Sasse 2003, job related mortality

Schulz et al. 2009

Smith et al. 2003, wolf management

Smith et al. 2015, increased kill rate

Suraci et al. 2016, trophic cascade

Treves et al. 2018

USDA APHIS NWRC 2007, Tech Note Evaluation of Remote Trap Monitors

USNPS 2017, state of Yellowstone vital signs

White 2012

Wielgus and Peebles 2014

Will et al. 2010, feral cat monitoring

Williams et al. 2011

Wilmers 2003, trophic cascade

Wilmers and Schmitz 2016

Windingstad et al. 1984, lead poisoning

Winnie and Creel 2016, trophic cascade

Wirsing et al. 2012

Wirsing and Ripple 2011

Wolf 2007

Woodroffe and Frank 2005, lethal control of African lions

Yaw et al. 2017

5.4 Documents Considered Upon Receipt.

We received documents attached to various comments that 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.

5.4.1 Documents not cited because they do not add substantively to the information and analyses in the EA.

Best et al. 1992a, lead exposure

Best et al. 1992b, lead exposure

Boronyak 2020, large carnivore coexistence

Callen et al. 2013

Church et al. 2006

Conner et al. 1998, coyotes

Conover and Roberts 2016, predator removal and sage grouse

Cooley et al. 2009, source populations in carnivore management

Craighead and Bedrosian 2009

Cronenwett 2011, newspaper, golden eagle population

Cruz-Martinez et al. 2012

Doherty et al. 2014, conservation actions to demography

Ecke et al. 2017

Eklund et al. 2017, effectiveness of PDM for livestock

EPA 1991, RED facts Inorganic Nitrate

Fisher et al. 2006

Franson and Russell 2014

Franson et al. 2009

Gangoso et al. 2009

Guthery and Beasom 1978, selectivity of neck snares

Hoffman et al. 1981

Hubert et al. 1996, evaluation of two traps

Hunt et al. 2006

Keefover-Ring 2009, war on wildlife report

Kendal and Scanlon 1979

Kendall et al. 1996

Kennedy et al. 1979

Ketcham 2016, newspaper, the rouge agency

Khorozyan and Waltert 2020, effectiveness of PDM for livestock

Kimble et al. 2020, lynx occupancy

Knudson 2012, newspaper, the killing agency

Kramer and Redig 1997

Lennox et al. 2018, efficacy of predator removal

Leopold 1964, predator and rodent control

Lewis et al. 2001

Mezquida et al. 2006, predator control and sage grouse

Miller et al. 2016, effectiveness of PDM

Miller et al. 1998

Miller et al. 2001

Moreira-Arce et al. 2018, effectiveness of PDM

Neumann 2009

Phillips 1996, testing of three snares

Ripple et al. 2014, trophic cascade

Roberts et al. 2011, exposure to traumatic events

Rochlitz et al. 2010, snares on animal welfare report

Rogers et al. 2009

Schulz et al. 2002

Schulz et al. 2006

Shivik et al. 2014, animal attendance at M-44 station

Shivik and Gruver 2002, animal attendance at M-44 station

Tobias 2020, newspaper, cyanide bombs

Treves et al. 2017, predators and public trust

Treves 2019, predator control

Van Eeden et al. 2018a, effectiveness of PDM

Van Eeden et al. 2018b, effectiveness of PDM

Van Valkenburgh et al. 2015, carnivores on Pleistocene

Wilkinson et al. 2020

WGFC 2020, furbearing, hunting, and trapping seasons

5.4.2 Documents added to and cited in the EA

Bedrosian and Craighead 2009, blood lead levels in eagles

Copeland et al. 2007, seasonal habitat associations of wolverine

Davidson 2010, testing turbo fladry

Domenich and Langler 2009

Gehring 2010, livestock protection dogs

Keel et al. 2002, lead exposure

Scasta et al. 2017, efficacy of PDM

Virgós et al. 2016, trap selectivity

Young et al. 2015, human-carnivore interactions

5.5 Documents Outside the Scope of the EA

We received documents attached to comments that were reviewed and determined to be outside the scope of the EA. These include:

Bartel and Brunson 2003, coyote bounty hunters

Bauer et al. 2017, effects of bird management

Beggs et al. 2019, effects of bird management

Belsky and Gelbard 2000, effects of cattle grazing

Berger and Gese 2007, wolf management

Beschta 2003, wolf management

Beschta 2005, wolf management

Beschta 2016, wolf management

Beschta and Ripple 2007, wolf management

Beschta and Ripple 2008, wolf management
Beschta and Ripple 2009, wolf management
Beschta and Ripple 2010, wolf management
Beschta and Ripple 2012a, wolf management
Beschta and Ripple 2012b, wolf management
Beschta and Ripple 2013, wolf management
Beschta and Ripple 2015, wolf management
Beschta and Ripple 2016, wolf management
Beschta et al. 2016, wolf management
Beschta et al. 2018, wolf management
Bryan 2014, wolf hunting and stress
Carter et al. 2011, moderating livestock grazing
Cornell Lab, webpage, Clark's nutcracker
Gao 2005, livestock grazing
Kimball and Schiffman 2003, livestock grazing
Miller et al. 2016, tiger and leopard management
Ripple and Beschta 2006b, wolf management
Ripple et al. 2015a, wolf management
Ripple et al, 2015b, wolf management

CHAPTER 6: LIST OF AGENCIES CONSULTED

Bureau of Land Management
Northern Arapahoe and Eastern Shoshone Tribes
United States Fish and Wildlife Service
United States Forest Service
Wyoming Animal Damage Management Board
Wyoming Department of Agriculture
Wyoming Game and Fish Department
Wyoming Office of State Lands and Investments

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Appendix A. What Predator Damage Management Methods and Techniques Are Used in the Current Program?

1.1 Introduction

WS-Wyoming 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-Wyoming conducts technical assistance (education and outreach) and operational wildlife damage management when requested.

Federal, state, tribal, and local regulations and APHIS-WS Directives govern the use of damage management tools by APHIS-WS. The following methods and materials are recommended or used in technical assistance and operational damage management efforts of the WS-Wyoming program. See Section 3.6.1.1 for a detailed discussion on humaneness for various IWDM methods.

1.2 What Non-Lethal PDM Methods Are Available to WS-Wyoming?

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-Wyoming are also available to other entities within the state and could be used by those entities to reduce damage. Depending on the method, the cooperator and/or the WS-Wyoming employee may implement it. Livestock producers and property owners are encouraged by WS-Wyoming 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 PDM 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 dogs, 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 poly-tape 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 maybe 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 employ 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. Guard dogs have been proven effective at reducing livestock losses caused by some types of predators (Gehring et al. 2010).

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 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-Wyoming only provides advice on the type of modifications that have the best chance of achieving the desired effect. WS-Wyoming 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 strategy 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 remain 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 device. 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-Wyoming employees receive safety training in transporting, using, and storing pyrotechnics, as required by WS Directives 2.615 and 2.625.

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 PDM 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-Wyoming and WGFD 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 by state and local law, can be used by WS-Wyoming personnel, per WS Directive 2.501. WS-Wyoming only relocates predators at WGFD's direction and coordinates capture, transportation, and selection of relocation sites with WGFD. 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 PDM Methods That May be Either Lethal or Non-Lethal Are Available to WS-Wyoming?

WS-Wyoming specialists can use a variety of devices to capture predators. Methods such as cage traps, cable devices, mechanical foot snare devices and trained pursuit dogs are used to non-lethally capture predators, but can be used to lethally capture predators, depending on the circumstance. For instance, WS-Wyoming 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. Most of these methods can also be used by WGFD, landowners, and their agents, as approved methods for PDM 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. 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-Wyoming most often uses this type of trap for black bears or grizzly bears. WS-Wyoming 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 WGFD.

Quick-Kill/Body Grip Traps are used by WS-Wyoming 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. 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.

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 have additional modifications with swivels and springs in the chain anchoring the 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-Wyoming follows state laws and regulations regarding the setting and checking of traps, cable devices and foot snares 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-Wyoming follows the laws and regulations regarding the setting and checking of traps, cable devices and foot snares 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 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-Wyoming 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-Wyoming and other certified entities.

Trained pursuit dogs are used by some hunters, agents of WGFD and WS-Wyoming 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 mountain lions. 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 PDM Methods Are Available to WS-Wyoming?

1.4.1 Aerial Shooting: Technical Assistance or Operational Assistance

Aircraft, both fixed-wing and rotary-wing (helicopters) are used by WS-Wyoming for PDM. The most frequent aircraft used for aerial shooting and harassment are the fixed-wing aircraft Piper PA-18 Super Cub and Bell 206 Jet Ranger. WS-Wyoming conducts aerial activities on areas only undersigned agreement and concentrates efforts to specific areas during certain times of the year. Additionally, WS-Wyoming 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-Wyoming 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 (USDA Wildlife Services 2015a) 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-Wyoming 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 Fish and Wildlife Act of 1956 (Airborne Hunting), any applicable State and local laws and regulations, individual WS-Wyoming 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 through 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-Wyoming personnel may either provide advice regarding ground shooting for predators as part of technical 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. 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, 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 (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-Wyoming complies with state laws, statutes, and WGFD 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.

WGFD, commercial operators, and landowners/resource owners can also use ground shooting for PDM, 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-Wyoming 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-Wyoming does not bury predator carcasses.

1.5 What Lethal and Non-lethal Chemical Methods are Available to WS-Wyoming?

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 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.

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 is 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 the 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-Wyoming 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-Wyoming with WDA. All pesticides used by WS-Wyoming are registered under the FIFRA and administered by EPA and WDA. All WS-Wyoming personnel who apply restricted-use pesticides are state-certified pesticide applicators and have specific training by WS-Wyoming for pesticide application per WS Directive 2.465. Gas cartridges may be used by private individuals in Wyoming.

1.6 What Tranquilizer and Immobilization Methods are Available to WS-Wyoming?

Tranquilizer and immobilization chemicals may be used by WS-Wyoming to aid in the humane handling of predators to avoid injury to the handler and the predator. Immobilization agents can eliminate pain and reduce animal's stress 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-Wyoming 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 provides 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 the 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.

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.

NalMed-A™ is a combination of nalbuphine, azaperone, and medetomidine. It is a non-DEA-regulated opioid agonist/antagonist-containing anesthesia combination. It is administered through intramuscular injection. Inductions are quick and characterized by minimal increase in body temperature and relaxed abdominal respiration. The effects are fully reversible through the use of atipamezole or naltrexone and recovery typically occurs within a matter of minutes. WS-Wyoming prefers to use NalMed-A™ for most of the species that are immobilized.

1.7 What Euthanasia Methods are Available to WS-Wyoming?

During PDM 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-Wyoming 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 (American Veterinary Medical Association 2013a) can be used by WS-Wyoming and are under the jurisdiction of FDA and/or DEA. WS-Wyoming 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 (American Veterinary Medical Association 2013b). 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. 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).

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-Wyoming 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 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 with 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 a humane method of euthanasia.

Cervical dislocation is a technique that may induce rapid unconsciousness and does not chemically contaminate tissue (American Veterinary Medical Association 2013a).

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 (American Veterinary Medical Association 2013a).

1.8 What Chemical Pesticide Methods are Available to WS-Wyoming?

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. The proper placement, size, type of bait, and time of year are keys to selectivity and successful use. Most chemicals are aimed at a specific target species.

Sodium cyanide is the only registered pesticide available for PDM in Wyoming (EPA Reg. No. 56228 - 15). This pesticide can be used by WS-Wyoming personnel and by private individuals who are certified by the WDA. The use of M-44s for PDM activities occurs in rural settings. Use of M-44s on private or sovereign tribal lands in Wyoming 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-Wyoming personnel that use the M-44 must be certified by the WDA since it is a restricted-use pesticide. WS-Wyoming 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 (U.S. Environmental Protection Agency 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.

Appendix B. Federal Laws and Executive Orders Relevant to WS-Wyoming 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 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. WS-Wyoming received a letter of concurrence from the Wyoming State Historic Preservation Office indicating the majority of WS-Wyoming PDM actions have no potential to cause effects to 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 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.

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. USFWS 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-Wyoming 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.

WS-Wyoming personnel use damage management methods as selectively and environmentally conscientiously as possible. All chemicals used by WS-Wyoming are regulated by the EPA through FIFRA, NDA, by MOUs with Federal land managing agencies, and by APHIS-WS Directives. Based on a risk assessment conducted in Section 3.10 of this EA, APHIS-WS concluded that when 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-Wyoming operational program properly disposes of any excess solid or hazardous waste and has been found to manage its chemicals appropriately (OIG Report 2015); Section 3.3.2, 3.10. 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.

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.