ENVIRONMENTAL ASSESSMENT

PREDATOR DAMAGE MANAGEMENT IN UTAH

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CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This chapter provides the foundation for:

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

Chapter 2 identifies the issues analyzed in detail in this EA. Chapter 3 describes the proposed action and alternatives evaluated in detail, with the rationale why some alternatives are not considered in detail, as required by the Council on Environmental Quality (CEQ) implementing regulations for NEPA at 40 CFR 1502.14(a). Chapter 4 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. Details of the different wildlife damage management (WDM) methodologies are included in Appendix E.

1.2 WHAT IS THIS EA ABOUT

This EA evaluates the potential environmental impacts of alternatives for the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) program involvement in predator damage management (PDM) in Utah. This EA analyzes existing and foreseeable future predator damage management related to the protection of livestock, poultry, crops, property, and designated wildlife species, and to protect human health and safety on public and private lands within Utah. The state of Utah encompasses 84,904 square miles, more than 54 million acres. WS-Utah is composed of northern and southern districts, and has agreements to conduct PDM throughout the state on federal lands under the administration of the U.S. Forest Service (USFS), Bureau of Land Management (BLM), and National Park Service (NPS), Tribal lands, Utah School Institutional Trust (State/School Trust) lands, county lands, and private lands.

This environmental assessment (EA) evaluates the impacts of four alternative approaches to PDM in Utah, including the current program. The purpose of the EA is to assist APHIS-WS to understand the options and the associated comparative impacts of each, and make an informed decision regarding managing the WS-Utah integrated predator damage management (IPDM) approach to responding to requests for assistance.

Even though the wildlife species covered in this EA can be biologically categorized in many different ways, this EA is focused on species that are considered meat-eating (*carnivorous)* predators, even if some of them eat food other than meat as part of their diet (*omnivorous)*. Therefore, for the purposes of this EA, we will refer to all of the covered species as "predators" from the order Carnivora and, from this point on in this EA, we will refer to the overall strategies and approaches used by WS-Utah as "WS-Utah IPDM." Actions taken by WS-Utah using IPDM strategies will be addressed as "PDM." If the EA is talking about WDM in general, it will be called wildlife damage management ("WDM"). It is important to remember that the WS-Utah assistance provided to requesters for managing predator damage evaluated in this EA is simply a component of the total WS-Utah WDM activities conducted in Utah. NEPA analyses of other components of the WS-Utah activities that do not involve predators are evaluated in separate documents.

This EA also provides sufficient analysis of impacts to determine if it can conclude with a Finding of No Significant Impact (FONSI) and Decision or and if an Environmental Impact Statement (EIS) is appropriate to complete. The alternatives considered in this EA vary regarding the degree of WS-Utah involvement in PDM, technical assistance (advice, information, education, or demonstrations), operational field assistance (active management of offending predators), and the degree of lethal and non-lethal methods available for use.

This Environmental Assessment (EA) evaluates ways that this responsibility could be carried out to resolve conflicts with predatory mammalian species in Utah. PDM is an important function of the WS-Utah Program. Many predators from the order Carnivora are part of Utah's wildlife heritage including 21 species that are native to Utah (Table 1.1). These species' populations are a vital and integral component of ecosystems in Utah, but sometimes individuals create concerns for people. Additionally, 3 introduced carnivore species are present in Utah that also create concerns when they are feral or free-roaming (Table 1.1).

The species in Utah that caused frequent damage to agricultural and natural resources, property, or threaten human health and safety with Work Tasks[1] in the Management Information System (MIS[2] for FY12[3]) through FY16 associated with them (Table 1), in order of numbers completed, were coyotes4 at 86%, black bears at 5%, mountain lions at 4%, red fox at 2%, raccoons at 1%,

1 A Work Task is defined as a visit to a property, or a portion of it, where a WS employee conducts field work. However, duration is not taken into account and, thus, a Work Task could be 10 minutes to 10 hours in duration.
2 MIS - Computer-based Management Information System used by WS for tracking Program activities. WS in New Mexico has had the SQL-based MIS system operational since FY92. However, a new system, the MIS 2000, replaced an old system 10/01/04. Differences in the systems have changed some outputs such as requests for assistance. Thus, information will be given for FY12 to FY16 in this document. MIS reports will not be referenced in the Literature Cited Section since most reports from the MIS are not kept on file. It is a database that allows queries to be made to retrieve the information needed.
3 FY 12 = federal fiscal year 2012, which is October 1, 2011 – September 30, 2012, and is the same for other years such as federal fiscal year 2016 = FY16
4 Scientific names of predators are given in Table 1.1.

and striped skunks at 1%. Several species were responsible for a minimal number of work tasks (<1% combined) and included bobcats, badgers, feral/free roaming cats, feral/free roaming dogs, long-tailed weasels, ermine or short-tailed weasels, and mink. Other species included in this EA that are present in Utah, but did not have work tasks associated with them between FY12 and FY16 and may or may not have historically include kit foxes, gray foxes, river otter, marten, feral domestic European ferrets, ringtails, and western spotted skunks; of these, the river otter and marten were the only two not to have damage or take documented for them in the MIS from FY92 thru FY16, but could. Thus, in all, WS-Utah could work on any of the 20 species mentioned and all of these species in this document will collectively be referred to as "*predators.*" WS consistently conducts PDM for many of these species and prior work effort is a good indicator of actual need for each species.

Table 1.1. Predator species included in scope of this EA, management authority, and distribution.

PREDATORS COVERED IN THIS EA				
Species	**Scientific Name**	**Management Authority**	**Distribution**	**Abundance**
Feral/Free-roaming Cat*	*Felis catus*	Local Officials	Statewide	Common
Bobcat	*Lynx rufus*	UDWR	Statewide	Common
Mountain Lion (*Cougar*)	*Puma concolor*	UDWR	Statewide	Common
Coyote	*Canis latrans*	UDWR & WS-Utah	Statewide	Abundant
Feral/Free-Roaming Dog*	*Canis lupus familiaris*	Local Officials	Statewide	Uncommon
Red Fox^	*Vulpes vulpes*	UDWR	Statewide	Abundant
Kit Fox	*Vulpes macrotis*	UDWR	West	Common
Common Gray Fox	*Urocyon cinereoargenteus*	UDWR	Mostly Statewide (not North)	Common
Black Bear	*Ursus americanus*	UDWR	Northeast - Central	Common
North American River Otter	*Lontra canadensis*	UDWR	Statewide	Rare
American Marten	*Martes americana*	UDWR	North - Northeast	Rare
European Ferret*	*Mustela putorius futuro*	Local Officials	Scattered – Mostly Urban	Rare
Long-tailed Weasel	*Mustela frenata*	UDWR	Statewide	Common
Short-tailed Weasel (*Ermine*)	*Mustela erminea*	UDWR	Mostly Statewide (not South)	Common
Mink	*Mustela vison*	UDWR	Northeast	Rare
Badger	*Taxidea taxus*	UDWR	Statewide	Common
Ringtail	*Bassariscus astutus*	UDWR	Southwest - East	Common
Raccoon^	*Procyon lotor*	Local Officials & WS-Utah	Scattered East – Urban Areas	Common
Striped Skunk	*Mephitis mephitis*	UDWR	Statewide	Abundant
Western Spotted Skunk	*Spilogale gracilis*	UDWR	Mostly Statewide	Uncommon
PREDATORS NOT COVERED IN THIS EA				
Lynx	*Lynx canadensis*	USFWS UDWR	Northeast	Vagrant
Northwestern Gray Wolf	*Canis lupus occidentalis*	USFWS UDWR	Northeast	Vagrant
Wolverine	*Gulo gulo*	UDWR	Northeast	Very Rare
Black-footed Ferret	*Mustela nigripes*	USFWS UDWR	East	Very Rare
TOTAL	**20 Sp. + 1 Ssp. + 3 Introduced Species**			

* Introduced Species ^ Commonly Translocated Species

A few other species of mammalian predators are, or potentially could be, found in Utah and include federally listed threatened and endangered (T&E) and sensitive species. These species could possibly be encountered during PDM activities targeting the predator species given above or could be a problem themselves (Table 1.1). The northwestern gray wolf, a large subspecies which was reintroduced to Yellowstone and Idaho, has been documented in Utah; Utah's native population, the Southern Rocky Mountain gray wolf (*Canis lupus youngi*), a mid-sized wolf, was believed to be extinct by the early twentieth century. Depending on the location in Utah, the northwestern gray wolf is not listed or listed as a T&E species; it is possible that the Mexican gray wolf (*C. l. baylei*) could come into Utah from populations released in south-central to southern

Arizona and New Mexico along the border between the two states. The threatened Canada lynx has been documented occasionally in Utah; most coming from a population reintroduced into Colorado. The endangered black-footed ferret, believed to have be extirpated from the wild in Utah in the early twentieth century, has been be reintroduced from captive ferret populations. Finally, the wolverine, a species that has been considered for listing, is a rarely encountered predator in Utah. PDM could be initiated to target these species for problems associated with them, but would be covered under other NEPA documentation and not this EA. These species will require close cooperation with the appropriate management agency(ies). These four species, the wolf, lynx, black-footed ferret and wolverine, will not be considered predators in terms of this EA for the remainder of the document (Table 1.1), but may be referenced.

Native predatory wildlife plays a vital role in a healthy ecosystem; however, predatory animals can also cause damage or pose a threat to resources, including threats to people. Predators have no intent to do harm. They use habitats (*e.g.*, feed, shelter, reproduce) where they can find a niche. If their activities result in lost value of resources or threaten human safety, people often characterize this as damage. When damage exceeds or threatens to exceed an economic threshold or poses a threat to human safety, people often seek assistance. The threshold triggering a request for assistance is often unique to the individual person requesting assistance and many factors can influence when people request assistance (*e.g.*, economic, social, aesthetics). Therefore, what constitutes damage is often unique to the individual person. What one individual person considers damage, another person may not consider as damage. However, the use of the term "*damage*" is consistently used to describe situations where the individual person has determined the losses associated with wildlife is actual damage requiring assistance (*i.e.*, has reached an individual threshold). Many people define the term "*damage*" as economic losses to resources or threats to human safety; however, "*damage*" could also occur from a loss in the aesthetic value of property and other situations where the behavior of wildlife was no longer tolerable to an individual person. The threat of damage or loss of resources is often sufficient for people to initiate individual actions and the need for damage management could occur from specific threats to resources.

WS-Utah targeted 13 species of predators from FY07 to FY16 with the top six species, the coyote, black bear, mountain lion, red fox, raccoon, and striped skunk for 99.3% of work tasks completed for cooperators with the value of their damage at 98.2% of all predator damage. Most PDM projects conducted by WS-Utah are focused on the protection of livestock and game animals (71.6% of WTs) and other agricultural resources (0.5%), natural resources (25.9%), human health and safety (1.3%), and property (0.7%). WS-Utah mostly conducts livestock protection with the primary target being the coyote (86% of WTs for predators). WS-Utah also conducts some disease surveillance and monitoring, mostly as part of a national interagency effort and almost exclusively from animals already taken. WS-Utah wildlife disease surveillance and research projects have focused on plague and tularemia for predators, but could change based on research or surveillance goals as determined scientifically.

The goal of the WS-Utah IPDM program, as conducted in the current program in Utah, is to manage predator damage, threats of damage, and risks to human or pet health or safety by responding to all requests for assistance, including technical assistance or direct operational assistance, regardless of the source of the request, private or public. WS-Utah proposes to continue responding to requests for assistance for damage management by mammalian predators for the protection of livestock, other agricultural and natural resources, property, and human/pet health and safety as well as collecting disease data for researchers. This EA includes analyses of the impacts associated with continuing to assist in predator damage management on all land classes, including federal, tribal, state, county, municipal, airports, and private properties in rural, urban and suburban areas where WS-Utah personnel have been and may be requested to assist, based on agreements between WS-Utah and the requesting entity. This EA also includes analysis of impacts of three other levels of predator damage management activities in Utah both involving and not involving WS-Utah in the alternatives. The alternatives are discussed Sections 3.2.1 through 3.2.4 their associated impacts and evaluated in Chapter 4.

The proposed action (Alternative 1) involves WS-Utah continuing use of all appropriate methods, used singly or in combination, to resolve damage caused by predators. The methods include cultural practices such as shed lambing, herding, and guard animals; habitat and animal behavior modification such as exclusion, chemical repellents, and hazing with pyrotechnics; and lethal operational actions such as trapping and shooting. In many situations, the use of nonlethal methods such as exclusion and cultural practices (e.g., shed lambing and use of a herder), and some lethal methods, consistent with state law, are the responsibility of the requestor to implement. Resource owners that are given direct PDM assistance by WS-Utah are encouraged to use reasonable and effective nonlethal management strategies and sound husbandry practices, when and where appropriate, to reduce ongoing and potential conflict situations.

All WS-Utah actions are conducted in accordance with applicable federal, state, tribal, and local laws, and in accordance with current agency Memorandums[5] of Understanding (MOUs) and interagency agreements between WS-Utah and the various federal and state resource management agencies. WS-Utah cooperates with Utah Department of Department of Wildlife Resources (UDWR), the Utah Department of Agriculture and Food (UDAF), and the Utah State Police (USP), as appropriate, for actions involving predator damage management.

1.2.1 Background

Across the United States, wildlife habitat has substantially changed as human populations have expanded and land has been transformed to meet varying human needs. These human uses, necessities, and desires may compete with the needs of wildlife or serve as an attraction to wildlife, which inherently increases the potential for conflicts between wildlife and people. Wildlife damage management, a specialized field within the wildlife management profession, is the science of effectively addressing damage or other problems caused by wildlife, and is recognized as an integral part of modern wildlife management (Berryman 1991, The Wildlife Society 2016). USDA, APHIS, WS is the federal agency authorized by Congress to conduct WDM to protect

[5] Memoranda is grammatically correct as well, but memorandums is now used more often and a better word here. Both have been used since Shakespearean times – the 1600s.

American agricultural, industrial and natural resources, property and human health and safety from damage associated with wildlife.

WS-Utah is a cooperatively funded program that provides assistance with WDM to the public, private entities and government agencies that request such services. Before WS-Utah responds to requests for assistance or conducts any WDM, a request must be received and an *Agreement for Control* must be signed by the landowner or administrator for private lands, or a comparable document must be in place for public lands. WS-Utah responds to requests for assistance when valued resources are lost, damaged, or threatened by wildlife. As requested, WS-Utah cooperates with land management agencies (e.g., BLM and USFS), wildlife management agencies (e.g., Utah Division of Wildlife Resources (UDWR) and U.S. Fish and Wildlife Service (USFWS)), and the Utah Department of Agriculture and Food (UDAF) to effectively and efficiently reduce wildlife damage. A WS-Utah response may be in the form of technical assistance or operational damage management. WS-Utah activities are conducted in accordance with applicable federal, state and local laws, Cooperative Agreements, "Agreements for Control", MOUs, and other applicable documents (WS Directive 2.210[6]). These documents establish the need for the requested work, legal authorities and regulations allowing the requested work, and the responsibilities of WS-Utah and its cooperators.

APHIS-WS' activities nationwide are conducted to prevent or reduce wildlife damage to agricultural, industrial, and natural resources; property; livestock; and threats to public health and safety on private and public lands in cooperation with federal, State and local agencies, tribes, private organizations, and individuals. The APHIS-WS program uses an Integrated Wildlife Damage Management (IWDM) approach (WS Directive 2.105), in which a combination of methods may be recommended or used sequentially or concurrently to reduce wildlife damage. These methods may include nonlethal methods, such as cultural practices, habitat manipulation, exclusion, or behavioral modification of the offending species. Implementation of IWDM may also require the relocation or lethal control of specific offending animals or the reduction of a local population by lethal means. Program activities are not based on punishing offending animals, but are conducted to reduce damage and risks to human and livestock health and safety, and are implemented as part of the WS Decision Model process for resolving conflicts with wildlife (Slate et al. 1992). Use of the APHIS-WS Decision Model facilitates development of site-specific IWDM strategies for each wildlife/human conflict addressed by APHIS-WS.

In 1996 the WS-Utah program prepared two separate EAs for the northern and southern districts which addressed the need to conduct predator damage management and the potential effects of various alternatives to respond to predator damage problems in Utah. In 2004, the southern EA was updated to meet changing needs within the program. Since that time, the WS-Utah program has reviewed and compared the analyses with more current program monitoring information to determine whether the original FONSIs were still appropriate. All of these reviews have, in fact, suggested that WS-Utah predator damage management activities continue to have no significant

6 The APHIS-WS Policy Manual provides guidance for APHIS-WS personnel to conduct wildlife damage management activities through Program Directives. The Policy Manual and its Directives are @ http://www.aphis.usda.gov/wps/portal/aphis/ourfocus/wildlifedamage under the Wildlife Damage – WS Program Directives tab, and will not be referenced in the Literature Cited.

adverse environmental effects. However, changes in the affected environment and new state legislation that amended coyote management after the 2004 Southern Utah PDM EA have prompted the Utah Wildlife Services State Director to initiate this new EA and combine the southern and northern districts into one statewide EA. The primary purpose of this EA is to address these more recently identified changes and to once again assess the potential environmental impacts of various program alternatives based on the most recent information available. This analysis will make use of WS-Utah program data for FY11 through FY15 and will comply with the findings of the consultation under Section 7 of the ESA.

WS-Utah could provide operational PDM or technical assistance for any of the predators listed, but currently receives the majority of request for assistance for coyotes, mountain lions, black bears, raccoons, red fox, and striped skunks. However, all predators discussed in Section 1.2 will be analyzed.

1.2.2 Wildlife Services- Utah

WS-Utah is a cooperative effort between USDA and UDAF. The state authority for the program is found in Title 4, Chapter 23 Utah Code Annotated. Under that code, the state created the Agricultural and Wildlife Damage Prevention Board (AWDPB), a nine member board that oversees the State role in predator damage management. Cooperative funds for WS-Utah to conduct WDM comes from the state (50%) federally appropriations (32%), private contributions (14%), and other federal sources (4%). In FY16, the WS-Utah budget was used for PDM management activities (81%), for airport and airbase safety (10%), for avian influenza monitoring efforts (4%), feral swine and other disease monitoring efforts (3%), and T&E species protection (2%).

The AWDPB has the option, at any time, of dissolving the cooperative program and implementing a state program. Restrictions on the APHIS program within the Grand Staircase/Escalante National Monument (GSENM) led to the development of state policy directing predation management within the GSENM as a state project. While the State has the resources, personnel and authority to conduct their own program (and have done so in the past) this EA analyzes the combined efforts under federal supervision of the cooperative program.

1.3 NEED FOR ACTION

The need for action is based on the need for a program to protect livestock, poultry, crops, other agriculture, natural resources including federally listed T&E species, property, and public and pet health and safety from predation or potential predation. Annually, WS-Utah responds to requests for assistance with coyotes, red foxes, mountain lions, black bears, raccoons, striped skunks and other predators that are deemed to be a threat to public health and safety. Throughout the state, WS-Utah has also receives requests to protect wildlife (*e.g.,* mule deer (*Odocoileus hemionus)*, pronghorn (*Antilocapra americana*) sometimes referred to as pronghorn antelope or American antelope, bighorn sheep (*Ovis canadensis*), nesting waterfowl, greater sage-grouse (*Centrocercus urophasianus*), the threatened Gunnison's sage-grouse *(C. gunnisoni*), ring-necked pheasant (*Phasianus colchicus*), wild turkey (*Meleagris gallopavo*) the endangered black-footed ferret *(Mustela nigripes),* the threatened desert tortoise *(Gopherus agassizii)* and the threatened Utah prairie dog (*Cynomys parvidens*)) from predation.

This EA evaluates PDM to protect livestock, poultry, crops, property and designated wildlife species as determined by the UDWR, and when coordinated with the UDWR or USFWS requests for T&E species protection from predation caused by, skunks, raccoons, badgers, coyotes, red fox, mountain lions and black bears in Utah. This EA will also analyze PDM to protect public health and safety from predators such as skunks, raccoons, coyotes, black bears, and mountain lions. Other program activities involving species other than the predators listed will be addressed in other NEPA documents.

1.3.1 Species Included in this EA

WS-Utah works with wildlife management agencies to conduct PDM. Utah's mammalian predators, with the exception of listed or rare sensitive species, are covered by this EA. All wildlife species and feral or free-roaming domestic animals are managed by different agencies with most native wildlife being managed by UDWR. Table 1.1 lists the animals that will be covered in this EA, the management authority for them, and their distribution in Utah.

1.3.2 How do People Feel about Wildlife?

Schwartz et al. (2003) summarized how human attitudes towards large carnivores evolved over time in Europe and North America and views focused on threats to life and property, moved to including utilitarian considerations, and finally to appreciating 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, while seeing the same group of deer feeding in your garden or commercial alfalfa field as a negative occurrence. Watching a coyote feeding on rodents in the snow may be exciting, but having the same coyote predate your pets or farm animals would be undesirable or frightening. Raccoons in the neighboring forest patch may be enjoyable to watch frolic, while the same raccoon in your garbage, henhouse, or attic intolerable.

We also have cultural perceptions based on our experiences, upbringing, and even childhood stories. Wolves and coyotes may be considered "*bad*" animals because they kill and eat other 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 happy just to know that certain 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*." At the same time, people will also expect to have animals that cause damage to property, economic security, or that pose a threat to people to be removed and sometimes killed, and since they are "*publicly-owned*" wildlife, done with assistance for entities responsible for managing them.

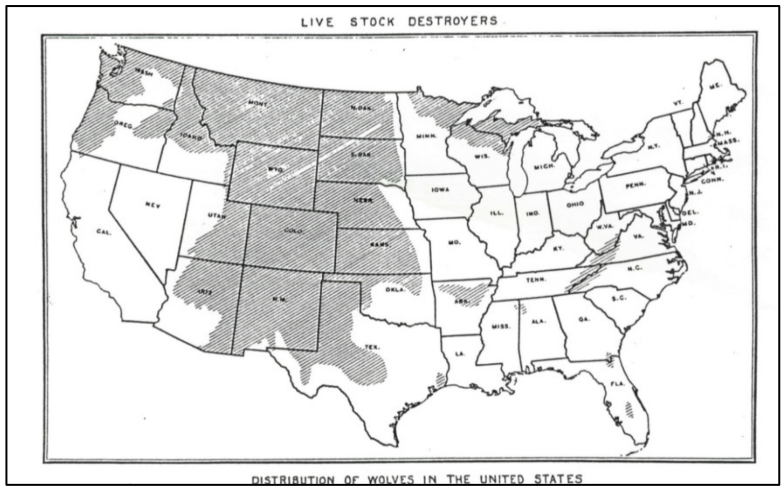
The values that people hold regarding wild animals differ based on their past and day-to-day experiences with them, as well as, identifying with the beliefs held by people they trust. For example, people who live in rural areas that depend on land and natural resources tend to consider wildlife from a more utilitarian viewpoint, such as for hunting while people in urban areas may tend see them more aesthetically. 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).

Table 1.2. Basic wildlife values (adapted from Kellert (1994) and Kellert and Smith (2000)).

TERM	DEFINITION – FOCUS OF VALUE
Aesthetic	The physical attractiveness and appeal of wild animals
Dominionistic	The mastery and control of wild animals
Ecologistic	The interrelationships between wildlife, natural habitats, humans, and the environment
Humanistic	Emotional affection and attachment to wild animals
Moralistic	Moral and spiritual importance of wild animals
Naturalistic	Direct experience and contact with wild animals
Negativistic	Fear and aversion of wild animals
Scientific	Knowledge and study of wild animals
Utilitarian	Material and practical benefits of wild animals

People have strong opinions about killing wildlife, dependent on a myriad of factors, such as social identity and experience and knowledge about different species (Lute and Attarii 2016). Determining whether an individual animal has intrinsic value (the inherent right of an entity to exist beyond its use to anyone else) is a predictor in support of conservation. Factors relevant to how people respond to wildlife can include intrinsic value attributions given to humans, some or all animals, and ecosystems; considerations such as moral, economic factors, the practicality with which one views wildlife, and cost-benefit analysis; and species characteristics, such as whether an animal is considered attractive, dangerous, endangered, familiar, nuisance, important to the economy, important to one's well-being, and important to ecosystems. The interactions of how individual people view themselves in relation to the environment, their economic security, the values associated with natural areas and property, their intrinsic values, and their needs and desires within the context of their relationship with specific individual animals and species create highly complex attitudes and associated behaviors towards animals, including potentially mutually exclusive ones. People may go to great lengths to save an individual identifiable person or animal, but become numb to saving nameless masses, "*psychic numbing*". 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, state, and federal governments using taxpayer money to manage those species for their continued existence and increased distribution, and population growth.

In the past, as settlers moved across the West, large predators such as bears, wolves, coyotes, and mountain lions 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, private predator removal agendas, local, state, and federal government programs, or habitat destruction. Maps were published by USDA in the late 1800's which gave the distribution of these "*Live Stock Destroyers*" (Figure 1). Taxpayer funds were once used to directly reduce or exterminate "*undesirable*" wildlife predator populations, such as wolves or grizzly bears. Annual Reports of the Bureau of Biological Survey, Predatory Animal Control Branch in Oregon noted many newspaper articles celebrating the last wolf in Oregon being taken. While they were in the process of exterminating wolves, the 1921 Annual Report stated:



"Trapper A. G. Ames, operating in the Santiam National Forest, captured and exceptionally large adult male timber wolf that was reported to have killed 11 head of cattle, numerous sheep, and a large number of deer. This wolf was known as the 'Canyon Creek wolf' and had been notorious in that section for a number of years. Mr. Ames took the wolf alive and he and a neighbor trapper packed it 25 miles over snow-covered trail and it was delivered in Portland alive, where it was placed on exhibition and visited by thousands of interested spectators. It is definitely known that certain individuals traveled over 100 miles to see this wolf. As a result of the death of this wolf, as well as 4 others, together with numerous bobcats and coyotes, both stock interests and those interested in game conservation are highly elated over Mr. Ames' work."

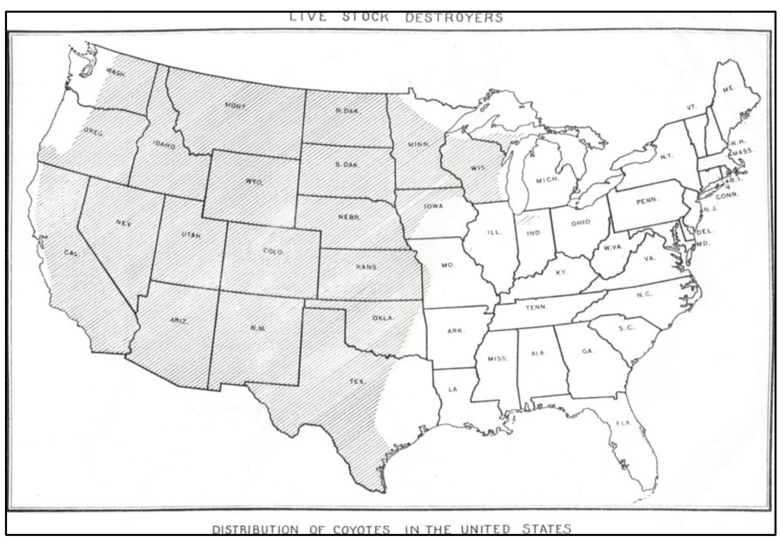


Figure 1. Range maps of coyotes and wolves published by USDA *circa* 1890. These were a few of maps that were published on "Live Stock Destroyers" as the set included other predators that were considered highly undesirable at the time.

At present, on the other hand, taxpayer funds are now used to protect and increase these same predator populations and habitats, recognizing their inherent ecological and social values within the framework of potential competition over natural and human resources and values.

Lute and Attari (2016) recognized that conflicts with wildlife have been ongoing, especially as humans have made and continue to make substantial modifications to the environment, land uses that have created such conflicts, and that lethal control may be more cost-effective than sweeping habitat protection strategies. Their study suggested that people may rely on default strategies such as habitat and ecosystem protection and moral considerations rather than considering the economic and social costs necessary for navigating difficult trade-offs and nuances inherent in decision-making regarding specific situations. Trade-offs can and do occur between different conservation objectives and human livelihoods (McShane et al. 2011); the authors argued 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, and this could be significant.

1.4 WHAT IS THE NEED FOR WS-UTAH IPDM ACTIVITIES?

Two independent government audits, one conducted at the request of Congress, the other based on complaints from the public and animal welfare groups to USDA, found that, despite cooperator implementation of nonlethal 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 protecting human health and safety, crops and livestock, other wildlife including T&E species, game, and recently reintroduced native species, as determined by the appropriate wildlife management agency, property and other assets. WS-Utah is authorized and directed by Congress to protect American resources and threats to public health and safety from damage associated with wildlife. The primary, statutory authority for the WS program is the Animal Damage Control Act of March 2, 1931, as amended (7 U.S.C. 426-426c; 46 Stat. 1468) and the Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988, Public law 100-102, Dec. 27, 1987. Stat. 1329-1331 (7 U.S.C 426C). UDWR is responsible for managing all protected and classified wildlife in Utah, except federally listed T&E species, despite the land class the animals inhabit (UCA §23-13-2). WS-Utah cooperates with UDWR and USFWS to protect species, identified by the responsible management agency, which are in need of short-term protection to reach recovery goals or to maintain sustainable populations.

In some cases, cooperators likely tolerate some damage and loss until the damage reaches a threshold where the damage becomes an economic, physical, or emotional burden. The appropriate level of tolerance or threshold before using nonlethal and lethal methods differs among cooperators, their economic circumstances, and the extent, type, duration, and chronic nature of damage situations. The level of tolerance would be lower for situations in which human safety or the potential for disease transmission from wildlife to humans is at risk. For example, action must be taken immediately in the case of aircraft striking predators at an airport crossing runways, which can lead to significant property damage and risk passenger safety. Another scenario may be where a coyote, which has habituated to humans or is diseased, starts acting aggressively in a residential neighborhood. In cases where the affected entity is concerned with the *threat* of damage, the entity has often experienced damage in the past and reasonably assumes that damage will occur again. The point at which a particular entity affected by predator damage reaches their tolerance threshold and requests assistance is affected by many variables specific to the affected entity. Therefore, it is not possible to set a predetermined threshold before a need for PDM exists. WS-Utah is not required to assess the economic value of a particular loss or threat of loss before taking PDM action, and WS-Utah responds regardless of the type of loss by the requestor. However, APHIS-WS does use a standard methodology for evaluating the value of a verified loss using national data and other factors, as well as economic values provided by the cooperator at the time of evaluation and service.

WS-Utah recognizes that increasing numbers of people are moving into urban and rural areas where populations of wildlife, along with their associated behaviors, exist and these new residents are often unfamiliar with them. Many become anxious with wildlife encounters, especially encounters with predators. Therefore, WS-Utah 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 wildlife conflicts. Typically, these sessions include information on the wildlife they will encounter and typical behaviors for them.

Predators in Utah cause a wide variety of damage and IPDM is conducted to resolve conflicts and reduce further losses from occurring.

Table 1.3. The average annual work tasks (WTs) and value of damage recorded for predator species that were given WS-Utah PDM assistance from FY12 to FY16 to protect different categories of resources from damage by predators.

AVERAGE ANNUAL WORK TASKS AND DAMAGE VALUE FOR PREDATORS RECORDED BY WS-UTAH FOR FY12-FY16										
Resource Category	**Agriculture**		**Property**		**Human Health & Safety**		**Natural Resources**		**Annual Average FY12-FY16**	
Species	**WTs**	**Value**	**WTs**	**Value**	**WTs**	**Value**	**WTs**	**Value**	**WTs**	**Value**
Badger	2	$0	0.4	$0	0.2	$0	12	$0	14	$0
Black Bear	639	$70,287	-	-	0.8	$0	31	$0	671	$70,287
Bobcat	44	$410	-	-	1	$0	21	$0	66	$410
Feral Cat	-	-	-	-	-	-	10	$0	10	$0
Coyote	8,856	$193,044	21	-	49	$0	3,407	$5.931	12,332	$198,975
Feral Dog	2	$959	1	$2,400	-	-	-	-	3	$3,359
Red Fox	230	$1,410	5	$0	45	$0	46	$0	326	$1,410
Mountain Lion	495	$50,650	1	$180	20	$0	100	$10,588	616	$61,418
Mink	-	-	0.2	$0	-	-	-	-	0.2	$0
Raccoon	41	$445	57	$0	33	$0	41	$0	172	$445
Striped Skunk	1	0	17	$0	43	$0	34	$0	94	$0
Long-tailed Weasel	0.4	$2,488	-	-	-	-		$0	0.4	$2,488
Short-tailed Weasel	-	-	-	-	-	-	0.2	$0	0.2	$0
Total	10,310	$319693	103	$2,580	192	$0	3,702	$10,594	14,305	$338,792

1.4.1 NEED TO PROTECT LIVESTOCK FROM PREDATORS

1.4.1.1 What is the Contribution of Livestock to Utah's Economy

Livestock production contributes significantly to the economy of the counties and communities throughout the state. Agriculture generated $1.8 billion in cash receipts in Utah in 2013 (UDAF 2015). Livestock production, including cattle, domestic turkeys and sheep, are the primary agricultural industries, and accounted for 72% of all agricultural cash receipts statewide in 2013 (UDAF 2015).

Livestock predation causes economic loss to livestock owners. Table 1.4 as reported by UDAF (2015) for Calendar Year 2014 and Table 1.5 as reported by WS-Utah shows reported livestock losses by species. Without effective PDM to protect livestock, predation would be higher (Nass 1977, 1980, Howard and Shaw 1978, Howard and Booth 1981, O'Gara et al. 1983).

The 2015 Utah breeding sheep inventory, including replacement lambs, totaled 280,000 head (UDAF 2015). The adult sheep inventory in 2015 was 230,000 head, and ewes for breeding, one year old and older totaled 220,000 head. The 2014 lamb crop was 235,000 head (UDAF 2015), and lambs for breeding replacement were estimated at 40,000 head in 2015, and rams one year old and older totaled 10,000 head (UDAF 2015). Market sheep and lambs were estimated at 20,000 head (UDAF 2015).

Utah cattle and calf inventory, as of January 1, 2015 totaled 780,000 head (UDAF 2015). Beef cow replacement heifers were estimated at 78,000 head and other heifers not intended for replacement totaled 64,000 in 2015. The January 1, 2015 inventory of steers weighing 500 pounds or more was 78,000 head. Calves weighing less than 500 pounds as of January 1, 2015 totaled 70,000 head and the 2014 calf crop was 385,000 (UDAF 2015). Because the herds are migratory and use federal, state and private lands, the numbers of livestock fluctuate by county and time of year. Additionally, domestic turkeys are produced in large numbers in Sanpete County.

1.4.1.2 Is Livestock Predation a Problem?

Nationally, sheep loss due to predators represented 39% of the total loss of sheep and lambs from all types of mortality, accounting for 247,200 animals killed, valued at $20.5 million. The National Agricultural Statistics Service (NASS) within USDA surveys producers to determine these losses. Of these losses to predators, 91.1% of them occurred from known predator species, whereas 8.9% occurred from unknown species (NASS 2010; Table 1.4). Since the 2009 NASS survey did not contain the specific breakdown of losses by predator species at the national scale, the 2004 NASS survey is used here. NASS conducts the most comprehensive surveys of the status of agriculture in the United States. The results of NASS surveys used in this EA are those that are pertinent to Utah, either nationally or statewide, and that are the most recent.

Table 1.4. The percentage of losses attributed to specific predator species in the United States and the associated amount of damage in terms of head of cattle-calves (NASS 2010) and sheep-lambs (NASS 2004) and dollars lost for each.

RESOURCE	SHEEP/LAMBS			CATTLE/CALVES		
PREDATOR SPECIES	**No. Head Killed**	**Value ($) of Loss**	**% of All Predators**	**No. Head Killed**	**Value ($) of Loss**	**% of All Predators**
Coyotes	135,600	$10,707,000	60%	116,700	$48,185,000	53%
Dogs	29,800	$2,807,000	13%	21,800	$10,067,000	10%
Mtn. Lions & Bobcats	23,800	$1,915,000	11%	18,900	$9,221,000	9%
Bears	8,500	$769,000	4%	2,800	$1,415,000	1%
Other[1]	26,500	$2,099,000	12%	59,700	$29,587,000	27%
TOTAL	**224,200**	**$18,297,000**	**100%**	**219,900**	**$98,475,000**	**100%**

[1] Includes livestock losses when predator species was unknown or unverified.

These losses occurred despite sheep operators spending $9.8 million on nonlethal methods comprised of fencing (52.5%), night penning (32.9%), guard dogs (31.8%), and shed lambing (30.8%) in 2004 (NASS 2005) and cattle operators $188.5 million on nonlethal methods such as guard animals (36.9%); exclusion fencing (32.8%); frequent checking (32.1%); and culling older livestock to reduce predation or other risks (28.9%) in 2010 (NASS 2011). The survey did not include information on any lethal management that might have been occurring simultaneously.

Utah sheep ranchers lost 43,500 sheep and lambs to all causes during 2014 (UDAF 2015). The largest single cause of death in lambs before docking was from coyotes, which killed 5,200 head accounting for about 68.0% of all lamb losses before docking from predators in 2014. Coyotes also accounted for the largest number of lambs killed after docking, totaling 8,500 head or about 70% of the after docking losses from predators (Table 1.5) (UDAF 2015). Losses of sheep one year old and older to coyotes were 2,800 head and the single largest cause at 54% of all losses to predators. Total losses to coyotes in FY14 were 16,500 head which was 66% of all losses of sheep and lambs in Utah (UDAF 2015).

Table1.5. Sheep and lamb predation losses in Utah in 2014 as reported by UDAF (2015).

Species	Lambs before Docking	Lambs after Docking	Adult Sheep	Total
Bear	100	1,700	800	2,600
Bobcat	200	200	0	400
Coyote	5,200	8,500	3,200	16,900
Dog	100	200	400	700
Fox	400	0	200	600
Mountain lion	500	1,700	900	3,100
Total	**6,500**	**12,300**	**5,500**	**22,900**

Cattle and calves are most vulnerable to coyote predation at calving time and less vulnerable as they get older and larger. On the other hand, mountain lion and bear predation occurs from spring through summer when cattle are moved to higher elevations; calving occurs at lower elevations in late winter and early spring. Sheep and lambs remain vulnerable to coyotes and mountain lions throughout the year, and to black bears when they are grazed at the higher elevations. Lambs can also be vulnerable to red fox predation in the spring, primarily at the lower elevations.

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 1978);
    - Lambs ranged from 12% to 29% and ewes 1% to 8% when producers were compensated for losses in lieu of PDM (Knowlton et al. 1988);
    - 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 1975);
    - Adult sheep and lambs can range from 8.3% to 29.3%, respectively (Henne 1975, Munoz 1977, O'Gara et al. 1983);
    - Lambs could be as high as 22.3% (McConnell 1995 in: Houben et al. 2004).

- Losses with direct PDM activities in place:
    - Adult sheep 1.6%, lambs 6%, goats and kids 12%, and calves 0.8% (Bodenchuk et al. 2002);
    - Lambs 1% to 6% (Knowlton et al. 1988);
    - Lamb losses can be as low as 0.7% (Nass 1977, Tigner and Larson 1977, Howard and Shaw 1978, Wagner and Conover 1999, Houben et al. 2004);
    - Lamb loss proportion to coyote predation was reduced from 2.8% to less than 1% on grazing allotments in which coyotes were removed 3 to 6 months before summer sheep grazing (Wagner and Conover 1999).

Many studies have shown that coyotes inflict high predation rates on livestock. In Utah from FY12 through FY16, WS-Utah documented that coyotes were responsible for 60% of the hoofed livestock losses, mostly sheep and lambs (Table 1.6). Mountain lions can also inflict a high rate of predation on livestock. Shaw (1989) reported that all of the mountain lions in his Arizona study area depredated calves. A study in southeast Arizona conducted by Cunningham et al. (1999)

indicated that out of 370 mountain lion scats collected, 34% contained cattle remains. In Utah, mountain lions accounted for an annual average of 16% of hoofed livestock losses from FY12 through FY`16. Black bears also can cause high predation losses, primarily while livestock are in the high country of Utah. For FY12 –FY16, black bear in Utah accounted for an annual average of 23% of the hoofed livestock losses (Table 1.6). Red foxes, bobcats, and feral dogs were responsible for a few losses, a combined 1% (Table 1.6). Other species involved in poultry predation included long-tailed weasels and raccoons from FY12 through FY16 (Table 1.5).

Table 1.6. The average annual livestock and poultry lost to predators between FY12 and FY16 in Utah as recorded by WS-Utah.

Annual Average Number of Livestock Lost and Their Value in Utah for FY12-FY16										
Livestock	**Sheep**		**Cattle**		**Other Hoofed Livestock**		**Poultry**		**Total**	
Species	**# Lost**	**Value**	**# Lost**	**Value**	**# Lost**	**Value**	**# Lost**	**Value**	**# Lost**	**Value**
Black Bear	487	$59,284	12	$46,284	2	$1,746	-	-	**501**	**$107,314**
Bobcat	12	$2,012	-	-	-	-	0.4	$8	**12**	**$2,020**
Coyote	1,240	$146,280	65	$40,590	22	$5,983	11	$191	**1,338**	**$193,044**
Feral Dog	1	$145	1	$814	-	-	-	-	**2**	**$959**
Red Fox	12	$1,410	-	-	-	-	-	-	**12**	**$1,410**
Mountain Lion	341	$46,341	4	$2,159	6	1,977	6	173	**357**	**$50,650**
Raccoon	-	-	-	-	-	-	10	445	**10**	**$445**
Long-tailed Weasel	-	-	-	-	-	-	360	$1,746	**360**	**$1,746**
TOTAL	**2,093**	**$255,472**	**82**	**$89,847**	**30**	**$9,706**	**387**	**$2,563**	**2,592**	**$357,588**

Connolly (1992) and Oakleaf et al. (2003) determined that only a fraction of the total predation is reported to or confirmed by WS. Connolly (1992) also stated that based on scientific studies and livestock loss surveys from NASS, WS only confirms about 19% of the total adult sheep and 23% of the lambs actually killed by predators. WS-Utah Specialists do not try to find every head of livestock reported to be killed by predators, only to verify that a problem exists that requires management action. Because of the State's compensation program, which pays ranchers all or a portion of the value of their confirmed livestock losses from mountain lions and bear predation, WS-Utah Specialists are directed to investigate and confirm a higher number of livestock suspected to be killed by these predators. However, because cattle are managed differently on summer ranges, losses of calves to predators could go unnoticed for longer periods of time, until the evidence that would have been used to confirm predation is destroyed by scavenger, weather, or other environmental elements.

To do a cost benefit analysis for PDM, the one factor necessary to determine this is the number of livestock actually saved if PDM had not been initiated. Many livestock losses occur prior to WS-Utah being involved with PDM on a property. However, to conduct the cost-benefit analysis it is the number of sheep or calves that would have been killed if predation was not stopped. Although it is impossible to accurately determine the amount of livestock saved from predation by WS-Utah, it can be estimated. Scientific studies reveal that in areas without some level of PDM, losses of adult sheep and lambs to predators were as high as 8.4% and 29.3%, respectively (Henne 1977, Munoz 1977, O'Gara et al. 1983) as compared to areas with PDM where losses are approximately 0.5% and 4.3%, respectively (USDI 1979). Where WS-Utah protected lambs and sheep, in FY15, reported and confirmed losses were only 0.18% of the lambs and 0.09% of the sheep protected. Similarly, where WS-Utah protected calves, predation rates were only 0.03% of the total calves protected; calf predation rates are typically lower than sheep. Thus, it can be assumed that WS-Utah PDM has been effective at minimizing losses.

Livestock are an important component of the local economies throughout the state. Livestock and poultry predation reported to WS-Utah from all predators in Utah annually averaged $360,000 for FY12 through FY16. The predators responsible for l for this value were coyotes (54%), black bears (30%), mountain lions (14%), bobcats (1%), and minimally for red fox, feral dogs, raccoons, and long-tailed weasels. These dollar values represent data collected from only those producers that had *Agreements for Control* with WS-Utah to protect their livestock.

UDAF (2014) estimated Utah statewide predation losses of sheep and lambs at $4,529,000. Because not all damage is reported to WS-Utah, or even reported at all, the predation confirmed by or reported to WS-Utah represents only a fraction of the total predator loss. It must be noted that these losses occurred with a PDM in place, and losses would likely have been much greater without PDM.

Predation is rarely distributed equally among livestock producers. Some livestock producers could have virtually no losses while others will suffer extreme losses, and losses may vary from year to year.

1.4.1.3 What Are Livestock Producers Doing to Prevent Predation?

The NASS (1998) statewide damage survey results identified that, of those that reported, wildlife damage prevention expenses exceeded $6 million in 1997, with $1.3 million of the total costs specific to protecting all livestock species. Preventative measures used included fencing, hazing, guarding, and other methods (NASS 1998). Table 1.7 shows the percentage of producers surveyed that used nonlethal strategies to prevent losses of cattle, calves, (NASS 2011) and sheep (NASS 2005) from predators in Utah. Culling refers to the removal of older and more vulnerable livestock from the inventory.

Table 1.7. Percentage of Utah livestock operations that use specific nonlethal methods for the protection of cattle and sheep (NASS 2005, 2011). Producers often use more than one nonlethal method at a time in efforts to reduce predation rates.

Nonlethal Method	Cattle	Sheep
Exclusion Fencing	79%	48%
Culling	22%	42%
Guard dogs	18%	31%
Frequent Checks	18%	24%
Carcass Removal	13%	33%
Herding	7%	14%
Night Penning	0.5%	28%
Scare/Harassment Tactics	0.4%	6%
Shed Lambing	-	49%
Changing Bedding	-	28%
Llamas	-	23%
Donkeys	-	8%
Other	-	5%

WS-Utah is typically contacted by landowners who have attempted several nonlethal strategies on their own with little or no success managing the problem. After receiving a request for assistance, WS-Utah assesses the situation to determine if the nonlethal methods previously conducted by the landowner were appropriate and carried out correctly, given the circumstances. Additional nonlethal methods may be recommended and or implemented by WS-Utah if deemed potentially effective by field personnel; sometimes, however, resolution of the conflict requires supplemental lethal control. Appendix E provides more detail on both nonlethal and lethal PDM methods.

1.4.1.4 Indirect Impacts of Livestock Predation

Although direct losses of livestock due to predation are often conspicuous and economically significant, they likely underestimate the total impact on producers because they do not consider indirect effects of carnivores as a result of livestock being exposed to the threat of predation without being killed (Howery and DeLiberto 2004, Lehmkuhler et al. 2007). Shelton (2004) suggested that the value of depredated livestock from predators is only a portion of the actual damage concerning the actual costs that predators impose on livestock producers including increased costs associated with efforts to mitigate predation, which may include night confinement, improved fencing, early weaning, choice of grazing area, or increased feeding costs from the loss of grazing acreage.

The presence of predators near cattle can invoke a fear response in the cattle. Fear is a strong stressor (Gregory and Grandin 1998). Stress can result in disease and weight loss, reduces the value of meat, and interferes with reproduction. Stress prior to slaughter is thought to cause "dark-cutters," meat which is almost purple (Fanatico et al. 1999). Dark-cutters are severely discounted because they are difficult to sell (Fanatico et al. 1999). Chronic stress inhibits immune responses, which increases illness and decreases performance of livestock and humans alike. Many infectious diseases result from a combination of viral and bacterial infections and are brought on by stress (Faries and Adams 1997). Harassment due to predators may directly cause weight loss due to increased energy expenditure associated with running and loss of sleep, but may also indirectly reduce the ability of ruminants to convert plant nutrients into weight gain due to decreased rumination time (Howery and DeLiberto 2004).

The stress of being repeatedly chased can cause cattle to abort calves, calf early or give birth to a weak calf (Lehmkuhler et al. 2007). Chebel et al. (2004) discovered that heat stress (>29° Celsius) prior to artificial insemination resulted in lowered conception rates for high producing dairy cows. Dairy cows exposed to high heat index values during peri-implantation may have a greater risk of pregnancy loss (Garcia-Ispierto et al. 2006).

Harassment by predators may cause livestock to become nervous or aggressive. Aggressive or nervous animals may hurt humans and the other cattle that are around them. Not only are they dangerous but they will also stress other cattle and reduce their performance as well. Fear based behavior is likely to be the main cause of accidents due to a horse kicking or a cow or steer becoming agitated in a chute. Reducing fear improves both welfare and safety for humans and animals (Gregory and Grandin 1998).

The current recommendations to improve health in a cattle herd are to avoid overcrowding, rotate the cattle to fresh areas and avoid keeping them in the same areas year round (Lehmkuhler et al. 2007). Moving cattle too often results in increased stress, poorer performance and more sick cattle. Having to keep the cattle by the buildings to avoid predators is contrary to Best Management Practices for livestock production and may result in increased risk of exposure to pathogens (Lenehan et al. 2004), and, for some producers, increased need for supplemental feed. Concentrating cattle in small areas may increase the risk of transmitting foodborne pathogens due to the increase in bacterial populations around the cattle and the immunosupression due to the stress of crowding (Lehmkuhler et al. 2007.). Recent research has shown that the prevalence of pathogens in the soil decreases as the distance from hay bale rings is increased (Lenehan et al. 2004). It is widely accepted that postpartum cows and newborn calves should be moved to “clean” pastures as soon as possible following parturition to decrease the risk of disease transmission (Lehmkuhler et al. 2007.).

In Utah, most of the depredations occur during the spring and summer grazing season. Moving cattle closer to barns or occupied building sites often requires removing cattle from pastures and placing them in areas where increased foraging pressure may necessitate supplemental feeding. This may require use of feed that would ordinarily be used in the winter. Winter feed is the most costly feed input for cow-calf operations based upon Standardized Performance Analysis data. Producers forced to move cattle closer to barns or occupied building sites and use winter feed during the grazing season will have lower financial returns (Lehmkuhler et al. 2007).

1.4.2 NEED TO PROTECT WILDLIFE FROM PREDATORS

Predation is a natural part of healthy ecosystems. However, changes in environmental conditions, often associated with human activity (e.g., habitat loss, fragmentation or alternation, introduction of invasive species), or a combination of human-induced changes and natural factors may disrupt the relationships between predator and prey and result in situations where predation may be limiting or threatening the long term viability of a prey species (Diamond 1992). Agricultural development, landscape fragmentation, and encroachment of human populations may increase the diversity and density of predators (Summers et al. 2004, Coates and Delehanty 2010, Dinkins et al. 2014). Certain species of predators such as coyotes, raccoons, and feral cats do well in areas near people whereas other species such as wolves and grizzly bears do not, often because the new habitat created is more suited to some species. In situations where some predators become overabundant, agencies with regulatory responsibility for maintaining wildlife populations may consider PDM as one of several tools to help restore sensitive species or enhance prey populations to meet game management objectives. Limited information suggests that predator management may provide short-term relief for a population sink (Hagen 2011).

Interactions between predators and prey are complex and depend on a wide range of factors such as habitat quality, availability of alternate prey, environmental conditions, life history of the species involved and interactions with other species in the ecosystem (Gese and Knowlton 2001, Hagen 2011). The role of predators in the population dynamics of prey species has been investigated for decades but, due to the complexity of these relationships and the fact that relationships between predators and prey may be dependent on site- and species-specific conditions, it is difficult to accurately determine the magnitude of the role of predation in prey species dynamics. Additionally, predation may work in combination with other factors, such as habitat quality. For example, predation may only be a limiting factor for the population if habitat is poor. Under these conditions the best long-term strategy may be to improve habitat instead of conducting PDM or only conduct PDM until such time as habitat quality has improved and predation is no longer a limiting factor.

Successful PDM programs for the enhancement of wildlife populations also requires a thorough understanding of the limiting factors for the population. Projects to enhance bird populations by increasing nesting success have achieved short-term goals to enhance fall bird populations, but failed to increase the number of breeding birds because of population constraints that are not related to the breeding season (e.g., predation in winter). Typically, a particular habitat will only support a set number of individuals from a population and is primarily changed by habitat modifications.

Research to precisely define all factors needed to fully understand site-specific predator-prey systems is often expensive, complex, and may take years to complete. Natural resource management agencies must balance the need to act to enhance or protect sensitive wildlife populations promptly with gaps in knowledge of the precise factors impacting local wildlife populations and understanding of the potential environmental consequences of management actions. Consequently, natural resource management agencies often implement adaptive management approaches that include concurrent work to address multiple factors that may be impacting the population, monitoring of project impacts, and adjustment of management actions over time to best achieve management objectives. This enables the natural resource management agency to realize any potential benefits of management actions while concurrently obtaining information needed to make improved management decisions.

Natural resource management agencies understand that predator-prey relationships are complex, and predator removal projects may not be successful. Consequently, agencies may test PDM projects on small areas and for short time periods before committing resources to PDM for long-term projects

Research data shows that PDM has the potential to benefit populations of both game and non-game wildlife including T&E species. A PDM project undertaken to protect livestock augments wildlife management objectives set by the Utah Wildlife Boards (UWB) and UDWR, and T&E species objectives set by USFWS. Numerous scientific reviews (Connolly 1978, Sinclair 1991, Skogland 1991, Ballard et al. 2001) have examined the role of predation as a regulator of prey populations and found a variety of effects. Connolly (1978), in his review of effects of predation on ungulates, indicated a selective review of the literature could reinforce almost any view on the role of predation. He reviewed 45 studies that indicated predation was a limiting factor or regulating influence and 27 studies where predation was not a limiting factor. He concluded predators acting in concert with weather, disease, and habitat changes could have important effects on prey numbers. Since Connolly's review, scientists have continued to debate whether predation is a significant regulating factor on ungulate populations (Messier 1991, Sinclair 1991, Skogland 1991, Boutin 1992, Van Ballenberghe and Ballard1994). However, it is generally recognized that a lack of PDM could adversely affect certain species (Connolly 1978, Schmidt 1986).

Ballard et al. (2001) reviewed studies primarily conducted since the mid-1970's, summarized predation impacts to prey, and made recommendations where predation management may be beneficial to deer populations. They noted that similarities existed in studies where PDM was effective, including PDM when deer populations were below habitat carrying capacity, where predation was identified as a limiting factor, if predator populations were reduced enough to be effective, when PDM efforts were timed just prior to reproduction of predator or prey, and where efforts were focused at a site-specific scale. Conversely, PDM was ineffective when deer populations were at or near habitat carrying capacity, when predation was not a limiting factor, where predator populations were not effectively reduced, and where efforts were conducted on a more regional scale.

Predator management for the protection or enhancement of a prey species is contentious. Management agencies considering PDM for the protection of other wildlife must consider and balance a highly diverse range of public values, ethics, and concerns. Public concerns include the ethics of, even the appearance of, favoring the well-being of one species over another; the morality of killing a predator so that more game animals are available to hunters; concerns about letting an abundant or overabundant species that thrives in human-altered landscapes adversely impact other wildlife including T&E species; the desire to maintain hunting opportunities and associated traditions and cultural values; and the appropriateness of using an agency to remove predators that could be taken by hunters and trappers. Members of Native American Tribes have unique spiritual relationships with specific wildlife species and ecosystems as a whole and question the appropriateness of killing one species to benefit another, especially if underlying habitat issues are impacting the prey population.

PDM is typically not used as a stand-alone solution for enhancing the success of other wildlife species, but is used when the management agency has determined that predation is having a negative impact on recruitment (i.e., survivorship of newborn animals to adulthood) or is a limiting factor in the success of the wildlife species of concern. It is important to note that PDM actions are generally only requested by a managing wildlife agency as a supplement to other management actions that enhance game species survival and success. The appropriate land management agencies (e.g. USFS or BLM), generally in coordination with UDWR, normally implement the other activities, such as habitat restoration and improvements, and sometimes disease management.

Revenue derived from recreation, especially recreation related to wildlife and the outdoors, is increasingly important to the economy of Utah. Southwick (2011) estimated the total economic impact from hunting in the United States to be $76.5 billion. In Utah, local economies benefit from these recreational activities. Hunting alone provided more than $1 billion to local economies and provided more than 11,500 jobs in Utah. Southwick (2011) also estimated the economic effect from deer hunting in the United States to be $39 billion and in Utah deer hunting alone provided

2,376 jobs and generated more than $307 million to local economies. In addition, migratory bird hunting generated more than $139 million in Utah and provided more than 877 jobs for Utah residents and upland game bird hunting generated more than $34 million and provided 216 jobs to the residents of Utah. As a result, the maintenance of game populations and associated recreation opportunities is important to UDWR, which has the responsibility for managing wildlife for the benefit of Utah and its residents.

Throughout the state, WS-Utah has received requests primarily from wildlife management agencies (i.e. UDWR and USFWS) to protect wildlife including mule deer, pronghorn, bighorn sheep, nesting waterfowl, sage-grouse other upland bird species, black-footed ferrets, desert tortoises, and Utah prairie dogs from predation. UDWR or USFWS may identify additional species in need of protection, but the need for action in these cases would be similar to those already mentioned; this EA would be supplemented as necessary. From FY12 through FY16, WS-Utah had 3,702 WTs associated with protecting natural resources from predators (Table 1.3) including coyotes (92% of the WTs), mountain lions (3%), red foxes (1%), raccoons (1%), striped skunks (1%), black bears (1%), and bobcats, badgers, feral cats and short-tailed weasels (1% combined) These requests may result from efforts to reintroduce species, intensively manage small critical habitats, or to temporarily assist species recovery. Long-term or widespread predator removal for the protection of wildlife species is generally not an objective of the UDWR. Rather predator removal is performed for a short duration in localized management areas to recover underperforming wildlife species.

Predation on game species is well documented and can adversely affect survival and recruitment of individuals into a population, especially when environmental factors (*i.e.,* weather, habitat, prey populations, etc.) are such that they do not favor the prey species. Factors such as predator densities, prey densities, weather conditions, vegetative cover and vulnerability can influence survival and recruitment of a species in a population. Under certain conditions, predators, primarily coyotes, have been documented as having a significant adverse effect on deer, pronghorn, bighorn sheep, game bird populations and T&E species, and this predation is not necessarily limited to sick or inferior animals (Pimlott 1970, Bartush 1978, USDI 1978, 1995, Hamlin et al. 1984, Neff et al. 1985, Wehausen 1996). Based on research and experience, many wildlife management agencies, including the UDWR, have found that predator damage management can increase deer fawn, pronghorn fawn and game bird survival where predation is affecting the ability of these populations to maintain or increase their recruitment. UDWR has requested WS-Utah assistance with PDM for the protection of designated wildlife species.

1.4.2.1 Effects of Predation on Deer

Mule deer are a big game species in Utah. Populations of mule deer have fluctuated historically, but have been in sharp decline over the past 15-20 years. Some reasons for declining numbers include degraded habitat in terms of reduced forage productivity from land uses and practices, invasive plants and weeds, weather, fire management, human population growth and development, and climate have all likely contributed to the recent decline in mule deer numbers in Utah.

The WS-Utah program is occasionally requested to assist in mule deer population recovery efforts by providing short-term predator management. Requests are received from UDWR and then plans are set by specific unit-by-unit projects in coordination with local UDWR biologists. These projects are based on local knowledge of the area, existing predation management projects in or near the targeted areas, and the level of allocated funding provided for each unit. These actions target predators during the times when mule deer fawns (late spring and summer) or adults (during winters with deep snow) are most vulnerable to predation. Efforts consist of coyote removals in areas that meet specific State criteria for predator management intended to stem the decline of mule deer populations. WS relies on UDWR to make this determination and does not know from year to year where they would request such actions.

Connolly (1978) reviewed 68 studies of predation on wild ungulate populations and concluded that in 31 cases, predation was a limiting factor. These cases showed that coyote predation had a significant influence on white-tailed deer and mule deer, pronghorn and bighorn sheep populations. Hamlin et al. (1984) observed that a minimum of 90% summer mortality of fawns was a result of coyote predation. Pojar and Bowden (2004) found for mule deer fawns in Colorado that 75% of predation mortality occurred by July 31. One study in the central Sierra Nevada in California found that predation was the largest cause of fawn loss, resulting in the death of 50.6% of all fawns during the first 12 months of life. In this instance, mountain lions were the main predator; however, coyotes still accounted for 27% of all predation (Neal 1990). Mackie et al. (1998) documented that high winter loss of mule deer to coyote predation in the Missouri River Breaks of north-central Montana was the cause for 95% of the fawn mortality during the winters of 1976-86. Remains of four to eight week old fawns were also common in coyote scats (feces) in studies from Steele (1969), Cook et al. (1971), Holle (1977), Litvaitis (1978) and Litvaitis and Shaw (1980). Mule deer fawn survival was significantly increased and more consistent inside a predator-free enclosure in Arizona (LeCount 1977, Smith and LeCount 1979). Hamlin et al. (1984) observed that a minimum of 90% summer mortality of fawns was a result of coyote predation. Trainer et al. (1981) reported that heavy mortality of mule deer fawns during early summer and late autumn and winter was limiting the ability of the population to maintain or increase itself. Their study concluded that predation, primarily by coyotes, was the major cause for low fawn survival on Steens Mountain in Oregon.

Garner (1976), Garner et al. (1976), and Bartush (1978) determined the mortality of radio-collared white-tailed deer fawns in the Wichita Mountains of Oklahoma to be 87.9 to 89.6% with predators being responsible for 88.4 to 96.6% of the mortality. Garner (1976) further stated that inter-specific behavioral observations indicated that coyotes may find fawns by searching near single does. Beasom (1974a) stated that predators were responsible for 74% and 61% of the fawn mortality for two consecutive years on his study area. Teer et al. (1991) documented that coyote diets contain nearly 90% deer during May and June. They concluded from work conducted at the Welder Wildlife Refuge, Texas that, "*Unequivocally coyotes take a large portion of the fawns each year during the first few weeks of life*." Cook et al. (1971) stated that, "*Apparently, the neonatal period is a critical one in the life"* of white-tailed deer. Remains of 4 to 8 week old fawns were also common in coyote scats (feces) in studies from Steele (1969), Cook et al. (1971), Holle (1977), Litvaitis (1978), Litvaitis and Shaw (1980). Other researchers have also observed that coyotes are responsible for the majority of fawn mortality during the first few weeks of life (Knowlton 1964, White 1967, Cook et al. 1971, Salwasser 1976, Trainer et al. 1981, Whittaker and Lindzey 1999). During other studies, designed to examine the impact of coyote predation on deer recruitment or coyote food habits, similar observations were noted (Steele 1969, Cook et al. 1971, Holle 1977, Litvaitis 1978, Litvaitis and Shaw 1980). Bates and Welch (1999), in Utah, stated that coyote and black bear predation on fawns could be significant and slow recovery of already depressed deer herds. They further stated that research showed mule deer to be the principal prey item of mountain lions and suggested mountain lion predation could contribute to slow recovery of depressed prey populations.

Guthery and Beasom (1977) demonstrated that after coyote damage management, deer fawn production was 70% greater after the first year and 43% greater after the second year on their study area. Stout (1982) increased deer production on three areas in Oklahoma by 262%, 92%, and 167% the first summer following coyote damage management and increased production 154% for the three areas. Mule deer fawn survival was significantly increased and more consistent inside a predator-free enclosure in Arizona (LeCount 1977, Smith and LeCount 1976, Arizona Department Game and Fish 2004).

Garner (1976), Garner et al. (1976), LeCount (1977), and Teer et al. (1991) stated that PDM may increase annual deer recruitment and survivability, but that impacts from other causes (*e.g.,* drought, disease, hunting, livestock grazing, etc.) play a major role in achieving management objectives. Knowlton and Stoddart (1992) reviewed deer productivity data from the Welder Wildlife Refuge following coyote reduction. Deer densities tripled compared with those outside the enclosure, but without active management, ultimately returned to original densities due primarily to malnutrition and parasitism.

Impacts of mountain lion predation on mule deer populations are difficult to determine due to numerous factors that can affect mule deer herds, such as differences in deer and predator densities, species of predators, weather, disease, human harvest, and whether the prey population is at habitat carrying capacity. In California, mountain lion predation was found to be the primary cause of a significant decline in mule deer in the Sierra Nevada Mountains (Harrison 1989). A three-year Oregon study found mountain lion predation of adult mule deer as the leading cause of mortality, accounting for 33% of all known mortality (Mathews and Coggins 1997). A study of a wintering mule deer herd in Hells Canyon, Idaho showed a 25% annual mortality rate for adult does from 1999-2001 (Edelmann 2003), primarily due to mountain lion predation. A review of published studies addressing deer-predator relationships by Ballard et al. (2001) indicated determining the impacts of predation were confounded by numerous factors; however predation may be a significant contributor in some areas under certain conditions.

In Utah, UDWR implemented predator management plans on 15 deer herd units in 1996 based on recommendations and guidelines established by UWB (Bates and Welch 1999). As a result of PDM, deer populations increased toward management objective on seven units and the post-season fawn:100 adult ratio increased on at least 11 units. Increased precipitation the recent years undoubtedly contributed towards increased deer recruitment. However, predator management may have had a positive effect as deer recruitment increased in units with increased mountain lion removal and when the number of coyotes removed exceeded 40 per year (Bates and Welch 1999). Additionally, the comparison units used for this analysis included areas where WS-Utah conducted predator damage management for summer sheep protection.

Mule deer are known to be a preferred prey species of mountain lions in Utah (Seidernsticker et al. 1973, Ackerman 1982, and Mitchell 2013). In 2015, UDWR updated its mountain lion management plan. Utah mountain lion harvest was increased in specific units where mule deer are below population management objective. In the new mountain lion management plan, mule deer population abundance and survival estimates will be used to help determine annual mountain lion harvest recommendations (UDWR 2015). The plan states that it is to "Manage cougar populations to reduce predation on big game herds that are below objective when cougar predation is considered a potential limiting factor for herd growth or recovery. Consider development of a predator management plan and implement according to UDWR policy W1AG-4 if annual recommendations are not meeting the needs of the unit."

Although positive results have been documented from the predator management plan, continued decline in several mule deer units in Utah prompted the Utah legislature to pass the Mule Deer Protection Act in early 2012. This new law requires UDWR to reduce coyote populations to help protect declining mule deer. The state has increased funds to the WS-Utah aerial program to bolster PDM efforts in specific deer herd units. The amount of effort applied in an individual unit may vary from year to year based on need at the request of UDWR. With this new law, UDWR implemented a coyote control program that encourages members of the public to take coyotes in regions where high mule deer predation occurs. Participants in the coyote control program receive $50 for each coyote that is removed from designated areas and is properly documented. Participants must register with the state, and complete an online training course.

1.4.2.2 Effects of Predation on Pronghorn

More than six decades ago, Jones (1949) believed that coyote predation was the main limiting factor of pronghorn in Texas. More recently, 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, Arizona. Neff et al. (1985) concluded from a 5-year radio tracking study that most of the coyotes that killed pronghorn fawns on Anderson Mesa were residents. This means that most of the depredating coyotes were present on the fawning grounds during fawning times. A 6-year radio telemetry study of pronghorn in western Utah showed that 83% of all fawn mortality was attributed to predation (Beale and Smith 1973). Trainer et al. (1983) concluded that predation was the leading cause of pronghorn fawn loss, accounting for 91% of the mortalities that occurred during a 1981-82 study in southeastern Oregon. They also stated that most pronghorn fawns were killed by coyotes and that known probable coyote kills comprised 60% of fawn mortality. Coyote predation was a leading cause of antelope fawn mortality on the National Bison Range at Moiese, Montana (Byers 1997). Major losses of pronghorn fawns to predators have been reported from other radio telemetry studies (Barrett 1978, Beale 1978, Bodie

1978, Von Gunten 1978, Tucker and Garner 1980). Pronghorn declines on Antelope Island, Utah have been attributed to coyote predation (A. Clark, UDWR, pers. comm. 2004).

Arrington and Edwards (1951) observed that following coyote damage management in Arizona, an increase in pronghorn populations occurred to the point where antelope were again huntable, whereas this increase was not noted on areas without coyote damage management. Coyote damage management on Anderson Mesa, Arizona increased the herd from 115 animals to 350 in 3 years, and peaking at 481 animals in 1971 (Neff et al. 1985). After coyote damage management was discontinued, the pronghorn fawn survival dropped to only 14 and 7 fawns/100 does in 1973 and 1979, respectively. Initiation of another coyote damage management program began with the removal of an estimated 22% of the coyote population in 1981, 28% in 1982, and 29% in 1983. As a result, fawn production increased from a low of 7 fawns/100 does in 1979 to 69 and 67 fawns/100 does in 1982 and 1983, respectively. Antelope population surveys on Anderson Mesa conducted in 1983 indicated a population of 1,008 antelope, exceeding 1,000 animals for the first time since 1960. In addition, a study in southeastern Oregon documented that in 1985, 1986 and 1987 an estimated reduction of 24%, 48%, and 58% of the spring coyote population in the study area resulted in an increase in antelope fawns from 4 fawns/100 does in 1984 to 34, 71, and 84 fawns/100 does in 1985, 1986, and 1987, respectively (Trainer et al. 1983). Similar observations of improved pronghorn fawn survival and population increases following coyote damage management have been reported by Riter (1941), Udy (1953), and Hailey (1979).

USFWS and conducted an aerial PDM operation on the National Bison Range in 1985 that resulted in an increase in antelope fawn survival for several years, but this eventually dropped in subsequent years (O'Gara 1994). Limited aerial PDM of coyotes was again conducted on the National Bison Range in 1992 and in 1993 primarily on the bighorn sheep range for the protection of lambs and to a lesser degree on the adjacent antelope habitat. However, these aerial PDM operations were conducted after coyotes had denned and very little follow-up coyote damage management was conducted during the crucial period of antelope fawning and bighorn lambing. The autumn antelope fawn survival was 8.2 fawns per 100 does in 1992, dropping to 1.8 fawns per 100 does in 1993 and 11.3 fawns per 100 does in 1994. The fall antelope fawn survival count on the National Bison Range for 1995 was 87.5 fawns per 100 does and the best survival of twins that had ever been documented on the National Bison Range.

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.

1.4.2.3 Effects of Predation on Bighorn Sheep

Two bighorn sheep subspecies are native to Utah: Rocky Mountain and desert bighorn sheep. California bighorn sheep inhabited portions of the Great Basin in Nevada and Idaho. However, genetic evidence did not support a distinction between Rocky Mountain and California bighorn sheep (Ramey 1993). Indiscriminate hunting, loss of habitat through human use and fire suppression, lack of healthy water, unregulated grazing by domestic livestock, and parasites and diseases carried by domestic livestock all contributed to the near extirpation following pioneer settlement. Few Rocky Mountain bighorn sightings occurred in northern Utah as late as the 1960's. Present populations are the result of reintroductions, but they still occupy only a small percentage of their historic range. Northern Utah now supports twelve Rocky Mountain and California bighorn herds with a population estimate of 2,200 Rocky Mountain bighorns, and 770 California bighorns.

Desert bighorns inhabiting southern Utah also suffered near extirpation due to similar causes as the Rocky Mountain bighorn. By the 1960's only a small population of desert bighorns remained along remote portions of the Colorado River. Currently, Utah has 12 populations of desert bighorn sheep with a population estimate of about 2,000.

Land use changes have rendered much of the original bighorn sheep range unsuitable for occupancy, but considerable suitable habitat into which bighorns have been, or can be re-established, still exist. Mountain lion predation has been identified in the Bighorn Sheep Management Plan as a limiting factor for their populations and compromises restoration efforts (UDWR 2008).

Wehausen (1996) and Hayes et al. (2000) examined mortality patterns of bighorn sheep. Their results indicate that even a small number of mountain lions may effect bighorn sheep survival, and population-level impacts may be exacerbated if adult female sheep are heavily preyed upon or displaced into less optimal habitat. Wehausen (1996) believed mountain lion predation was responsible for behavioral changes and winter range abandonment of bighorn sheep with a subsequent population crash in the Sierra Nevada. The bighorn population decline appeared to result from predator avoidance behavior, an indirect effect of mountain lion predation. Fecal nitrogen levels of bighorn sheep were higher before their winter range abandonment, suggesting that the sheep maintained higher nutritional levels and reproductive success when they seasonally migrated to their winter range. The reduced vigor of the bighorn sheep herd was attributed directly to predation by mountain lions plus the reduced survival and recruitment based on habitat selection from avoiding the mountain lions (*i.e.,* a secondary predation impact).

Hayes et al. (2000) suggested population-level effects were exacerbated when mountain lions killed reproductive-age females and their offspring. Sustained high levels of mountain lion predation apparently impeded recovery of the Peninsular Range sheep population in California. Bighorn sheep distribution and the numbers that their ranges support are dependent on the assortment of predators that confine them to those ranges (Wishart 2000).

In a study by McKinney et al. (2006), unmarked and radio-collared desert bighorn sheep were translocated to 12 areas in Arizona between 1979 and 1995. They reported that 14.6% (54/369) of radio collared bighorn sheep died due to mountain lion predation and that 75% (39/52) were killed less than one year after release. Of all known deaths, but excluding legal harvest, 64% were due to mountain lion predation, 20% due to accidents and natural causes, 11% due to disease and 5% due to bobcat or coyote predation (McKinney et al. 2006). Of all predator-related deaths, mountain lions accounted for 88% (McKinney et al. 2006). In a study by Rominger et al. (2004)

in New Mexico during 1993 where two translocated populations of bighorn sheep were established, mountain lion predation was the primary proximate cause (75%) of 16 known-caused mortalities of radio-marked sheep in the Sierra Ladron population. Mountain lion predation appears to have hampered desert bighorn sheep translocation efforts in Arizona, Colorado, New Mexico, Texas, and Utah (Krausman et al. 1999, Rominger et al. 2004).

In limited circumstances (*i.e.,* transplanted populations), at the request of the UDWR predation management may be necessary to protect bighorn sheep populations, especially where winter snow limits access to escape cover. In most bighorn sheep populations, coyote predation does not limit bighorn sheep. Mountain lions however, can exert significant predation pressure on bighorn sheep, both from primary predation and secondary effects in habitat selection (Wehausen 1996). For example, some bighorn sheep management plans call for a minimum viable population size of 125 sheep (UDWR Statewide Management Plan for Bighorn Sheep 2008). Predation management may be necessary where predation impacts a population to decline below that number or where alternative prey is limited.

In some desert bighorn sheep units, alternative prey would not support a mountain lion. In these areas, mountain lions depend on bighorn sheep to meet their energy requirements. When it is determined that bighorn sheep in these areas are limited by predation, any mountain lion found near the bighorn sheep are typically removed since they, more than likely, prey on and impact the local bighorn sheep population.

1.4.2.4 Effects of Predation on Sage-Grouse

Sage-grouse populations have declined throughout much of the western U.S. and in Utah during the last several decades due to a variety of environmental threats (Schroeder et al. 2004; Knick and Connelly 2011). In 2010, the U.S. Fish and Wildlife Service (USFWS) found that listing of the greater sage-grouse under the Endangered Species Act (ESA) was warranted on a range wide basis, but that further action was precluded at that time. On September 22, 2015, the (USFWS) announced that the greater sage-grouse did not warrant protection under the Endangered Species Act (ESA), and credited on-going rangewide, landscape-scale conservation efforts with significantly mitigating the threats to the greater sage-grouse across 90 percent of the species' breeding habitat.

UDWR and the West Desert Adaptive Resource Management (WDARM) Local Working Group submitted a request to WS-Utah to conduct red fox removal for sage-grouse recovery efforts in 2015. Sage-grouse inhabit 26 of Utah's 29 counties and much of its distribution throughout the state is influenced by the natural topography of the land. The current range of the species is believed to be 50% of the historic range (Beck et al. 2003). In 2013, UDWR published a conservation plan for greater sage-grouse identifying 11 Sage-Grouse Management Areas (SGMA's) throughout the state: Bald Hills, Box Elder, Carbon, Hamlin Valley, Ibapah, Panguitch, Parker Mountain-Emery, Rich-Morgan-Summit, Sheeprock Mountains, Strawberry, and Uintah. The 11 SGMA's, which account for more than 90% of their population in Utah, were organized to identify the greatest prospect for high-value, intensive conservation efforts for the species in Utah (UDWR 2013). UDWR (20013) identifies eleven categories of threats to greater sage-grouse populations in Utah. These threats are presented in a non-hierarchical order since not all of the threats exist in each SGMA. Predation was identified in UDWR (2013) as a "key threat" in most of the SGMAs.

In Utah, there are 400 known leks, 300 of which are active (UDWR 2013). Most of the Utah sage-grouse populations are characterized as being small (<500 breeding pairs) and occupy small fragmented sagebrush steppe habitats (UDWR 2013). Sage-grouse populations occupying habitats that are highly fragmented or in poor ecological condition may exhibit relatively low nest success, low juvenile recruitment, and poor adult survival, and likely related to increased predation (Gregg 1991, Aldridge and Boyce 2007). Populations of some of the most important grouse predators have increased dramatically during the last 100 years, 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 management strategy that effectively increases nest success and juvenile survival may be useful to offset some of the negative effects of poorer habitat. This approach might also allow a more rapid recovery of grouse populations following habitat restoration. 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 predator damage management for the protection of bird populations.

Presnall and Wood (1953) documented an example illustrating the potential of coyotes as predators on sage-grouse. In tracking a coyote approximately 5 miles to its den in northern Colorado, they found evidence on the way that a 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 female sage-grouse 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.

In some Utah populations, low chick survival during the first 2-3 weeks after hatching has been identified as a potentially limiting factor (J. Robinson UDWR, pers. Communication 2017). 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 And 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 confirmed for unidentified avian and other mammalian predators. Bunnell and Flinders (1999) also documented significant predation by red fox on sage-grouse in their study area in Utah, and sage-grouse management guidelines (Connelly et al. 2000) suggest that red fox populations should be reduced in or discouraged from expanding their range into sage-grouse habitats. WS-Utah personnel have found the remains of sage-grouse at red fox den sites and red fox abundance appears to be increasing in Utah. Native red foxes were found in only the montane areas of the high Rockies prior to wide spread settlement in the 1800s. To that matter, red foxes in Utah have expanded their population moving into all lowland areas and likely are invasive in much of Utah as genetic makeup of red fox in the Great Basin are from montane populations mixed with nonnative haplotypes (released fur farm or boreal red fox from Canada) (Statham et al. 2012). Thus, the need to protect sage-grouse from predation is also increasing. 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.

Cote and Sutherland (1996) reviewed and analyzed the results from 20 published studies where predator removal had been undertaken to assess its effects on bird populations. Their analysis suggested that removing predators consistently had a large, positive effect on hatching success and significantly increased autumn densities of the target bird species. Their analysis also suggested that predator removal did not consistently result in increased breeding populations in the year following predator removal. They speculated that this might be due to the action of density-dependency on avian populations, but noted that this has yet to be documented and deserves further research. They further suggested the possibility that predator removal does in fact increase breeding populations, but the increased breeding birds emigrate out of the area into nearby areas where population monitoring or predator removal may not be occurring.

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 common ravens (*Corvus corax*) 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. Slater (2003) however, reported on the effects on sage-grouse from coyote removal for livestock protection in Wyoming. Despite differences in predator abundance between study areas, no differences were observed in nest predation rates.

1.4.2.5 Effects of Predation on Other Upland Game Birds

Dumke and Pils (1973) reported that ring-necked pheasant 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 areas with and without PDM. They examined two variations of predator removal for 5 years, one targeting only red fox, and the other targeting badger, raccoon, striped skunks, and red fox. 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. Chessness et al. (1968) examined the effects of nest predator (primarily skunks, raccoons, and American crows (*Corvus brachyrhynchos*)) removal for three years on pheasant populations in paired treated and untreated areas in Minnesota; they reported a 36% hatching success in predator removal areas versus a 16% hatching success in nonremoval 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 study areas in southern Idaho and found consistently higher pheasant survival and productivity in predator removal areas as compared to similar nonremoval areas. Frey et al. (2003) reported on the results of a four year study to protect ring-necked pheasants in Utah. Removal of red fox, striped skunk and raccoons resulted in increased pheasant abundance on larger study sites (41.5 sq. km.) but not on smaller study sites (10.4 sq. km.).

Thomas (1989) in New Hampshire and Speake (1985) in Alabama reported that predators were responsible for more than 40% of nest failures of wild turkeys. Everet 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 also the leading cause of mortality in turkey poults, and Kurzejeski et al. (1987) reported in a radio-telemetry study that predation was the leading cause of mortality in hens. Wakeling (1991) reported that the leading natural cause of mortality among older turkeys was coyote predation, with the highest mortality rate for adult females occurring in winter. Other researchers report that hen predation is also high in spring when hens are nesting and caring for poults (Speake et al. 1985, Kurzejeski et al. 1987, Wakeling 1991).

1.4.2.6 Effects of Predation on Waterfowl

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 (*Poliocitellus franklinii*), badgers, black-billed magpies (*Pica husonia*) and American crows (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*) on their study area. Various studies have shown skunk and raccoon to be major waterfowl nest predators resulting in poor nesting success (Keith 1961, Urban 1970, Bandy 1965). On the Bear River Wildlife Refuge in Utah, striped skunks, red fox, and raccoons were documented as common predators of nesting ducks (West 2002).

In documenting an extensive study of 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 compared to areas without PDM. He also recommended that when conducting PDM, the entire complex of potential predators should be targeted or compensatory predation may occur by a species not under damage management, a phenomenon also observed by

Greenwood (1986). Rohwer et al. (1997) documented a 52% nesting success for upland nesting ducks in an area receiving PDM versus a 6% nest success in a similar untreated 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. Frey and Conover (2007), found that predator removal by WS-Utah was effective at controlling predator densities during the breading season and the following dispersal season on the Bear River Migratory Bird Refuge (BRMBR). Prior to predator removal on the BRMBR, waterfowl nest production was evaluated Utah State University researchers and BRMR employees. Researchers and BRMBR employees found less than 12 waterfowl nests annually on BRMBR before predator removal, but increased to more than 150 nests and 322 duck nests in the two years following predator removal (Frey and Conover 2007).

1.4.2.7 Effects of Predation on T&E Species

Utah Prairie Dog

Iron County is home to the Utah prairie dog, a federally listed threatened species. WS-Utah has been requested by the Utah Division of Wildlife Resources (UDWR) to conduct PDM to protect newly reintroduced Utah prairie dogs in their artificial burrow systems/chambers from badgers. Past reintroduction efforts have resulted in badgers digging up the chambers and destroying or disrupting the reintroduction efforts, as well as putting the newly reintroduced prairie dogs at risk of being preyed upon by other predators due their increased exposure. Predation has been suspected in limiting the recovery of the Utah prairie dog (USFWS 1991, 2012). Limited predator removals where Utah prairie dogs are transplanted may benefit the recovery effort by reducing predation and burrow destruction while also providing baseline disease prevalence data by monitoring predators in the recovery area.

Black-footed Ferret

Black-footed ferrets are endangered in Utah, but it is likely no wild population exists as the last credible sighting were in 1950s. USFWS, in cooperation with BLM, Colorado Parks and Wildlife, and UDWR, reintroduced ferrets into northwestern Colorado and northeastern Utah. This population was designated as an NEP population in accordance with Section 10(j) of the ESA (63 FR 52823-52841). The NEP area covers occupied portions of Rio Blanco and Moffat Counties in Colorado, Uintah and Duchesne Counties in Utah, and Sweetwater County in Wyoming. WS-Utah works with UDWR and Colorado Parks and Wildlife to provide protection for the black-footed ferrets from predators (coyotes, badgers, gray fox, and feral dogs) in the Wolf Creek NEP. Coyotes were the main cause of predation on ferrets at three reintroduction sites in Arizona, Montana, and South Dakota and hindered their successful reintroduction (Biggins et al. 2006a).

Desert Tortoise

In 1988, WS-Utah personnel were requested to remove coyotes from the Beaver Dam Slopes in Washington County to protect the desert tortoise. Anthropogenic changes to habitat increased desert tortoise predator numbers (Goodrich &Buskirk 1995), and predator management was recognized as a key component in desert tortoise recovery efforts (Esque et al. 2010, Gompper & Vanak 2008). Research conducted by Esque et al. 2010, within the Western Mojave Recovery unit of critical habitat for desert tortoise showed that 89 of 357 translocated desert tortoises were found dead within the first year of translocation, with the majority of mortality attributed to coyotes.

1.4.3 NEED TO PROTECT PUBLIC AND PET HEALTH AND SAFETY FROM PREDATORS

Predators can have direct and indirect impacts to people. WS-Utah responds to several requests for assistance involving predators annually with most requests for coyotes, striped skunks, raccoons, red fox, and mountain lions (Table 1.3). Requests can involve predators that are a direct threat such as those that are aggressive, indirect threat such as those that could harbor a disease that could spread to people such as rabies, or are perceived as a general nuisance such as a skunk living under a house.

Human encroachment into wildlife habitat and wildlife encroaching into human residential and other human-altered areas, often in response to available food, including pets, increase the likelihood of human-wildlife interactions. Those species that people are likely to encounter are those most likely to adapt to and thrive in human-altered habitats. In fact, several species in Utah have increased in abundance as a result of urban areas such as raccoons and coyotes. These habitat alterations may include landscaping vegetation, artificial pools, pet food, leashed and unleashed pets, garbage, piles of waste debris, and woodpiles that favor the presence of particular predators. Finally, many people enjoy wildlife including predators to the point of purchasing food specifically for feeding predators despite laws prohibiting this in Utah.

The constant presence of human-created refuse, readily-available water supplies, and abundant prey populations found in areas of human development often increase the survival rates and biological carrying capacity of wildlife species that are adaptable to those habitats. Often the only limiting factor of some wildlife populations living near human development is disease, which readily spreads among concentrated populations of wildlife congregated into small areas capitalizing on the unlimited amount of food, water, and shelter found within those human-altered habitats and mortality due to collisions with vehicles on roadways.

1.4.3.1 Risks Associated with Aggressive and Habituated Animals

As wildlife adapt 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 and become habituated to people, vehicles, and developed areas. With their natural fear of humans diminished, some individual animals may exhibit bold and even dominant behavior toward humans. If people respond by backing away, animals may become further emboldened. Animal behavior may then either appear to be or actually become aggressive, with aggressive posturing, a general lack of caution toward people, 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 rare nationally and in Utah.

WS-Utah responds to several requests for assistance involving coyotes, red foxes, mountain lions and black bears thought to be a threat to public health and safety annually. UDWR is responsible for managing black bears and mountain lions and has the primary authority for responding to potentially dangerous bear and mountain lion incidents. At the request of UDWR, WS-Utah assists with black bear and mountain lion damage. Requests from the public regarding potentially dangerous coyotes are referred to WS-Utah. These requests are given a higher priority and are scrutinized using the WS Decision Model (Slate et al. 1992 and WS Directive 2.201) described in Chapter 3 of this EA. When requests for assistance occur on Federal lands, the Federal land managing agency is also involved.

After several human-coyote interactions in southern California, Baker and Timm (1998) concluded that the use of foothold traps to capture and euthanize a few coyotes would be the best method to resolve the problem and have the most lasting effects. After a child was killed by a coyote in Glendale, California, city, County officials trapped 55 coyotes in an 80-day period from within one-half mile of the home, an unusually high number for such a small area (Howell 1982). WS-Utah assists many residents concerned about coyote attacks on their pets and their apparent loss of fear of humans.

Human interactions with black bears and mountain lions could occur wherever habitat or food sources overlap with human activities. Black bears and mountain lions may pose a potential threat when they habituate to urban or residential locations, or recreation areas such as campgrounds or picnic areas. UDWR responds to most such instances of nuisance or "*garbage can*" bears (bears adept at rummaging for food in trash cans or other containers) by live capturing them in culvert traps and relocating them before human contact occurs.

Although rare, mountain lion attacks on humans in the western U.S. and Canada have increased, primarily due to increased lion populations and human use of lion habitats (Beier 1992). No lion-caused fatalities have been documented in Utah, but recent fatal attacks in California and Colorado emphasize the need for awareness. During the FY12-FY16, WS-Utah responded to an annual average of 20 mountain lion incidents where they caused concerns to people (Table 1.3).

WS-Utah conducts the majority of the raccoon and skunk damage management in urban/suburban areas to protect property and public health and safety in situations where raccoons or skunks are living in very close proximity to home/property owners. Currently, Utah law Title 4-23 prohibits the relocations of raccoons. Combined with other laws preventing public discharge of firearms within city limits and ability to possess euthanasia drugs, the public's ability to manage nuisance skunks and raccoons in urban settings is limited. WS-Utah recommends that home owners that experience raccoon or skunk damage, alter access to property or to make it less desirable to raccoon or skunks (e.g., install chimney caps, remove debris, and remove food availability). In part, this issue is outside the scope of the EA, as WS-Utah is directed by Congress to reduce wildlife damage and does not have the authority to regulate what people can and cannot do on their private property to eliminate raccoon and skunk damage situations.

1.4.3.2 Risks Associated with Predators Transmitting Disease to Humans and Pets

Zoonoses (i.e., wildlife diseases transmissible to people) are a major concern of people 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 a 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. WS-Utah uses technical assistance to actively attempt to educate the public about the risks associated with pathogen transmission from wildlife to humans and pets.

The transmission of pathogens from wildlife to humans is not well documented nor well understood for most infectious zoonoses, and can be complicated by the potential for multiple sources of infection. Unless otherwise noted, the pathogens listed in this section are not currently monitored in predator populations by WS-Utah, but may be undetected or may be introduced to these populations in the future. While these zoonoses are known to circulate in other predator populations outside of Utah, not all of these pathogens have documented detections in Utah predator populations. WS-Utah currently conducts minimal sampling for diseases that can be transmitted to humans and pets in Utah, as part of the WS-National Wildlife Disease Program. However, WS-Utah remains available to assist UDWR or the Department of Public Health with active or passive sampling, as requested.

Individuals or property owners that request assistance frequently have the perception of potential disease risks from animals living in close proximity to people, from animals uncharacteristically roving in day light hours in residential areas, or from animals exhibiting a lack of fear of humans.

The most common disease concern of individuals requesting assistance is the threat of rabies transmission to people, pets, and companion animals. Rabies is an acute, fatal viral disease of mammals most often transmitted through the bite of a rabid animal that poses a threat to humans, either indirectly from exposure from pets or livestock that have been infected from bites of a rabid animal or directly from handling or from being bit by an infected animal. Rabid animals are often aggressive, with a tendency to bite. In Utah, the occurrence of rabies is rare, with bats being the common species causing transmission. Pets can be vaccinated against rabies and, if a human is exposed, rapid and early treatment is typically effective.

Since 1960, the transmission source of rabies in the United States has changed from primarily being transmitted by domestic animals to now about 90% or greater of all animal cases reported annually to CDC occurring in wildlife, primarily wild carnivores and bats (Krebs et al. 2000, CDC 2011). As rabies spreads in wildlife populations, the risk of human and pet exposure increases. The number of rabies-related human deaths in the United States has declined from more than 100 annually in the early 1900s to an average of one or two people per year in the 1990s, due to modern vaccine injections when administered promptly (CDC 2011). However, the costs associated with treatment can be between $1,000 and $3,000 or more (CDC 2011). In addition, the number of pets and livestock examined and vaccinated for rabies, the number of diagnostic tests requested, and the number of post-exposure treatments can be expensive.

Raccoons, coyotes, red fox, gray fox, skunks, and feral dogs have been implicated in outbreaks of distemper, which can be fatal to domestic dogs, but is not a threat to human health. Clinical signs of distemper include abnormal behavior, such as aggressive behavior and not showing fear of humans, which are similar to clinical signs of rabies. This can cause people that feel threatened by the possibility of disease transmission to request assistance after observing sick animals. The disease can be spread through direct contact with the aerosolized droplets of a coughing or sneezing host but also environmentally through shared food bowls and animal handling equipment. Additionally, the virus can be transmitted vertically from mother to fetus during pregnancy.

Coyotes, foxes, raccoons, feral cats and dogs, and other wildlife can carry the highly infectious parvovirus, after coming in contact with infected animals or contaminated feces (Berrada et al. 2006). Parvovirus is a common infectious domestic canine disease in the U.S. It has a high morbidity and mortality rate in unvaccinated and untreated dogs. Puppies and incompletely vaccinated dogs are the most at risk of infection, and affected puppies have the highest mortality rate (Martin et al. 2002, Nandi and Kumar 2010, Decaro and Buonavoglia 2012, Mitchell 2015). Wildlife can serve as a reservoir for the disease. When shed in feces, the virus is environmentally stable and extremely difficult to destroy.

Raccoons and skunks are known to carry diseases such as rabies, leptospirosis, toxoplasma gondii and both have species of ascarids (roundworms) that have the potential to cause serious human illness (Dubey et al. 2008). These two species also have the potential of spreading diseases like canine distemper and sarcoptic mange to domestic pets (Kuiken et al. 2005).

Leptospirosis bacteria, carried by striped skunks, raccoons, red fox, gray fox, and opossums can infect humans and pets. Transmission usually occurs by direct contact with urine-contaminated water or food. Pets are commonly infected when wildlife have access to water bowls or when they drink from streams. People living or working closely with animals, wild or domestic, have a higher risk of developing leptospirosis (World Health Organization 2012). Currently, WS-Utah is collecting blood samples as part of a nationwide research program conducted by the National Wildlife Research Center to determine the distribution and prevalence of *Leptospira* infection in canines and raccoons.

The raccoon roundworm, *Baylisascaris procyonis*, and skunk roundworm (*B. columnaris*) are common parasites of raccoons and skunks. While the *Baylisascaris* roundworms cause little or no clinical diseases in their natural host species, they can cause serious or fatal diseases in humans and domestic animals. Raccoon roundworm is transmitted through eggs shed in feces. When raccoons use human structures as a latrine (they tend to defecate in one area), feces can build up in attics, roofs, yards, and sandboxes increasing the odds that a person will come in contact with infected soil or feces. Children and adults with compromised immune systems are at increased risk of contracting the parasites when they are exposed to raccoon feces; human fatalities have been confirmed in the U.S. when the mature roundworm migrates to the brain. The roundworm can also migrate to the central nervous system and eyes. There is no test for roundworm infection, and medical professionals believe it may be an underrepresented cause of death among those suffering from encephalitis.

Mange, caused by a sarcoptic mite, infects foxes, raccoons and coyotes, causing fur loss and thickened crusting on the skin. Mange is transmitted to other animals and to pets and humans by direct contact or contact with blankets and other bedding, giving humans a red, itchy rash.

Echinococcosis infections (Hydatid disease) involves the larval stage of tapeworm that depends on wild ungulates and fox, coyote, and wolves for transmission, but can infect any animal. Tapeworm cysts can be found in the liver, other organs, nervous tissue, or bone. People become infected by accidentally ingesting the eggs when handling infected animals or by eating contaminated food, water, or soil. If not treated, it is potentially fatal.

Diseases and parasites affecting feral cats and dogs can have particularly serious implications to human health, given the close association of those animals with humans and pets. Feral cats and dogs are considered by most professional wildlife groups to be a non-native species that can have detrimental effect to the native ecosystems, especially in the presence of a human-altered landscape. However, some people view feral cats to be an extension of companion animals and pets that should be cared for and for which affection bonds are often developed, especially through feeding. Of special concern are those cats and dogs considered companion animals living part-time in a residence that are allowed to range freely outside the home for extended periods with no oversight or care by their owners during that time. If interactions occur between pets and feral animals of the same species, pets can become exposed to a wide-range of pathogens that are brought back into the home, where direct contact between the pet and their caretakers increases the likelihood of pathogen transmission. These animals are also likely to expose family members to a pathogen before diagnosis of infection in the animal.

Several known pathogens that are infectious to people have been found in feral cats and dogs, including *Pasteurella*, salmonellosis, cat scratch fever disease (*Bartonella henselae*), ringworm (*Tinea* spp.,) a contagious fungal disease contracted through direct interactions with an infected person, animal, or soil, and numerous parasitic diseases, including roundworms, tapeworms, and *Toxoplasma gondii*. These may not be life-threatening if treated early, but are transmissible. Pregnant women, children, and people with weakened immune systems are at increased risk of clinical disease if exposed to *Toxoplasma* (AVMA 2004). In 1994, five Florida children were hospitalized with encephalitis that was associated with cat scratch fever (AVMA 2004). The daycare center at the University of Hawaii at Manoa was closed for two weeks in 2002 because of concerns about potential transmission of murine typhus (*Rickettsia typhi)* and flea (*Ctenocephalides felis*) infestations. The fleas at the facility originated from a feral cat colony that had grown from 100 cats to over 1,000 cats, despite a trap, neuter, and release effort (AVMA 2004).

Plague (*Yersinia pestis*) and tularemia (*Franciscella tularensis*) are zoonotic diseases that also have been identified as potential bio-terrorism agents. Both plague and tularemia are diseases of wildlife, with the ability to cause severe disease in human populations. Despite the dangers these pathogens pose to people, there is still limited understanding about their transmission and persistence in the environment. Information on geographic distribution of the pathogens, habitat associations, and occurrence in different hosts and vectors is needed to better understand these diseases and the risk they pose to humans, domestic animals, and species of conservation concern (APHIS-WS 2016). WS-Utah is participating in the National Surveillance Plan by collecting blood samples from mammals, including predator species.

1.4.3.3 Wildlife Hazards to Aircraft and Passengers

Airports provide ideal habitat for many mammalian wildlife species including the large open grassy areas adjacent to brushy, forested habitat used as noise barriers and often being adjacent to water. Access to most airport properties is restricted, so predators living within airport boundaries are not harvestable during hunting and trapping seasons and are insulated from many other human disturbances. The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, MacKinnon et al. 2001, Dolbeer 2009). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1996), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996, Thorpe 1997, Keirn et al. 2010). Aircraft collisions with wildlife can also erode public confidence in the air transport industry as a whole (Conover et al. 1995).

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

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

Airports in Utah have requested assistance with managing threats to human safety and damage to property associated with predators that are present inside the air operating area and training to address problems associated with predators. From FY12 to FY16, civil aircraft reported striking an annual average of 1.8 predators annually in Utah, which included six red foxes and three striped skunks, all at Salt Lake International Airport (Federal Aviation Administration (FAA) 2017); the only other predator documented to be struck was a raccoon in FY08 from FY97 to FY11 (FAA 2017). The infrequency of aircraft strikes with predators does not lessen the need to prevent threats to human safety and the prevention of damage to property. Preventing damage and reducing threats to human safety is the goal of those cooperators requesting assistance at airports in Utah given that a potential strike could lead to the loss of human life and considerable damage to property. WS-Utah provides full-time assistance to two airports in Utah, Salt Lake International and Hill Air Force Base. For predator species considered in this EA, WS-Utah provided responses to 287 conflicts at these airports, with 49% for red fox, 28% for raccoons, 21% for skunks, and 2% for coyotes.

Predator populations near or found within the perimeter fence at airports can be a threat to human safety and cause damage to property when struck by aircraft. The predators 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 immediately 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.

1.5 DECISIONS TO BE MADE

Based on agency relationships and legislative mandates, WS-Utah is the lead agency for this EA, and therefore responsible for the scope, content, and decisions made. Issues related to the proposed action have been historically developed by an interdisciplinary team process involving USFS, BLM, USFWS, Utah School and Institutional Trust Lands Administration, UDWR, and UDAF. Because of the ongoing nature and similarities of the continued PDM work done in Utah, WS-UTAH has continued to confer and communicate any changes or issues needing discussion through annual and biannual meetings.

Based on the scope of this EA, the decisions to be made are:

- Should predator damage management as currently implemented be continued in the State?
- If not, how should WS-Utah fulfill their legislative mandate and responsibilities in the State?
- Might the proposal have significant impacts requiring an EIS analysis?

WS-Utah PDM activities are subject to the National Environmental Policy Act (NEPA) (Public Law 9-190, 42 U.S.C. 4321 et seq.). The APHIS-WS program follows the Council on Environmental Quality (CEQ) regulations implementing the NEPA (40 CFR 1500 et seq.) along with USDA (7 CFR 1b) and APHIS Implementing Procedures (7 CFR 372) as part of the decision-making process. NEPA sets forth the requirement that all 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.
- Including agencies and the public in their NEPA planning in support of informed decision-making.

Updates regarding WS-Utah implementation of PDM in Utah have prompted WS-Utah to initiate new analyses. The analyses contained in this EA are based on information and data derived from the APHIS-WS MIS database; data from the UDAF and UDWR regarding species under their jurisdiction; published and, when available, peer-reviewed scientific documents; interagency consultations; public involvement; and other relevant sources.

This EA describes the needs for resolving predator damage problems where WS-Utah typically provides assistance for requests from the public and other agencies. The EA identifies the potential issues associated with reasonable alternative ways and levels of WS-Utah assistance. It then evaluates the environmental consequences of the alternatives for WS-Utah involvement in PDM.

Wildlife damage management is a complex issue requiring coordination among state and federal agencies and tribes. To facilitate planning, efficiently use agency expertise, and promote interagency coordination with meeting the needs for action (Section 1.12), WS-Utah is coordinating the preparation of this EA with cooperating and consulting partner agencies, including UDWR, UDAF, FS, BLM, USFWS and the Utah State Police (USP). The WS-Utah program is committed to coordinating with all applicable land and resource management agencies including tribes when PDM activities are requested.

To assist with understanding applicable issues and reasonable alternatives to managing predator damage in Utah and to ensure that the analyses are complete for informed decision-making, WS-Utah has made this EA available to agencies, tribes, the public, and other interested or affected entities for review and comment prior to making and publishing the decision (either preparation of a Finding of No Significant Impact (FONSI) or a Notice of Intent to prepare an Environmental Impact Statement (EIS)). Public outreach notification methods for an EA include postings on the national APHIS-WS NEPA webpage and on www.regulations.gov, a direct mailing to known local stakeholders, electronic notification to registered stakeholders on www.GovDelivery.com. 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.

1.6 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT ANALYSIS

The geographic scope of the actions and analyses in this EA is statewide. WS-Utah has decided that one EA analyzing potential operational impacts for the entire State of Utah provides a more comprehensive and less redundant analysis than multiple EAs covering smaller regions. This approach also provides a broader scope for the effective analysis of potential cumulative impacts and for using data and reports from state and federal wildlife management agencies, which are typically on a state-wide basis.

Areas in which WS-Utah 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; wildernesses and wilderness study areas where authorized, and other places where predators may overlap with human occurrence, activities, and land uses and create conflicts. Utah covers an area of 84,904 square miles, 54 million acres and WS-Utah could work on any of it where assistance is requested with PDM. Utah has about 8.2 million acres of USFS lands, 22.8 million acres of land administered by the BLM, and 3.4 million acres of land administered by the Utah School and Institutional Trust Lands Administration. UDWR manages several types of wildlife management area's (WMA's), for waterfowl, upland, and big game species, and USFWS has refuges for migratory birds and sensitive species.

This EA analyzes planned and future predator management related to the protection of livestock, poultry, crops, property and designated wildlife species, and to protect human health and safety on public and private lands in Utah. The area encompassed by the WS-Utah Southern District is more than 34 million acres and the WS-Utah Northern District is more than 20 million acres. Throughout the state, cattle and sheep are permitted to graze on federal lands year-round. In many cases, WS-Utah spends only a few hours in a specific location and only on a few acres to resolve damage problems.

Damage problems involving predators may occur statewide resulting in requests for assistance from WS-Utah. Table 1.3 provides statewide data where WS-Utah responded to predator damage complaints for FY12 to FY16. Under the Proposed Action, PDM could be conducted on private, federal, state, tribal[7], county, and municipal lands in Utah with the permission of the appropriate land owner or manager.

The need for PDM has generally increased in recent years. This EA takes the potential increase in future requests for assistance into account by considering potential needs for PDM and the number of predators likely to be removed as a function of population size (Chapter 4). WS-Utah in coordination with UDWR and USFWS monitors predator populations and changes in sensitive populations; thus, PDM activities would reflect adaptive management adjustments to ensure sensitive species conservation. Depending on circumstances, these measures could be implemented by UDWR or USFWS and include measures such as restrictions on the use of lethal methods, changes in permits issued to landowners to respond to damage, and adjustments to hunter harvest seasons.

7 PDM would only be conducted on tribal lands at a Tribe's request/consent and only after appropriate documents had been signed by WS-Utah and the respective Tribe.

1.6.1 Native American Lands and Tribes

The United States and all its agencies, as fiduciary, owe a trust duty to the Native American Tribes. This duty includes a substantive duty to protect—to the fullest extent possible—the lands, assets, and resources on which the Tribe's treaty-reserved rights depend and to manage habitat to support populations necessary to sustain species hunted and gathered by Tribal members. The trust duty also includes a procedural responsibility to meaningfully consult with the Tribe to determine when treaty resources are likely to be impacted by federal agency actions and to avoid adverse impacts to treaty resources. According to the President's April 29, 1994 memorandum regarding Government-to-Government Relations with Native American Tribal Governments, federal agencies "shall assess the impacts of Federal Government plans, projects, programs, and activities on tribal trust resources and assure that Tribal government rights and concerns are considered during the development of such plans, projects, programs, and activities." Executive Order 13175 further provides that each "agency [within the federal government] shall have an accountable process to ensure meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications."

Tribal wildlife management decisions are outside the scope of this analysis and decisions made in this EA do not alter the tribes' authority or rights relating to wildlife management. However, this analysis does consider the types of assistance WS-Utah may offer the tribes, if requested. WS-Utah would only conduct PDM activities on tribal lands at the request of the tribe and only after appropriate authorizing documents were signed. If WS-Utah enters into an agreement with a tribe for PDM, this EA would be reviewed and supplemented, if appropriate, to ensure compliance with NEPA.

1.6.2 Site-Specific Analyses and Decisions Using the APHIS-WS Decision Model

Many of the species addressed in this EA can be found statewide within suitable habitat, and damage or threats of damage can occur wherever those species occur and overlap with human presence, resources, or activities. Wildlife damage management falls within the category of actions in which the exact timing or location of individual requests for assistance can be difficult to predict with sufficient notice to accurately describe the locations or times in which WS-Utah can reasonably expect to be acting. Although WS-Utah could predict some of the possible locations or types of situations and sites where some kinds of predator-related damage could occur, the program cannot predict the specific locations or times at which affected resource owners would determine that a damage problem has become intolerable to the point that they request assistance from WS-Utah. Planning for the management of predator damage is conceptually similar to federal or other agency actions whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they will occur are unknown but could be anywhere in a defined geographic area. Examples of such agencies and programs include fire and police departments, emergency clean-up organizations, and insurance companies. Although some of the sites where predator damage will occur can be predicted (Treves et al. 2004), all specific locations or times where such damage will occur in any given year cannot be predicted (Ruid et al. 2005). This EA emphasizes major issues as they relate to specific areas whenever possible, but many issues apply wherever predator conflicts and resulting management occurs. Therefore, WS-Utah must be ready to provide assistance on short notice anywhere in Utah to protect any resource or human and pet health or safety upon request.

The APHIS-WS Decision Model (Chapter 3.4) is the site-specific procedure for individual actions conducted by WS-Utah 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 include applicable WS Directives and policies, relevant laws and regulations, interagency agreements and MOUs, and cooperating agency policy and procedures.

The analyses in this EA are intended to apply to any action that may occur in any locale and at any time within Utah for which WS-Utah may be requested for assistance. Using the Decision Model (Section 3.4) for field operations, this EA meets the intent of NEPA with regard to site-specific analysis and informed decision-making, and provides the necessary timely assistance to agencies and cooperators per WS-Utah objectives.

The EA also addresses the impacts of PDM on areas where additional agreements may be signed in the future. Because the proposed action is to reduce damage and because the program's goals and directives are to provide services when requested, within the constraints of available funding and workforce, it is conceivable that additional WDM efforts could occur. Thus, the EA anticipates this potential expansion and analyzes the impacts of such efforts as part of the program.

1.6.3 Time Period This EA Is Valid

If WS-Utah determines that the analyses in this EA indicate that an EIS is not warranted (impacts are not significant per 40 CFR §1508.27), this EA remains valid until WS-Utah determines that new or additional needs for action, changed conditions, 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-Utah 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 nontarget take reported and associated impacts analyzed in the EA. Monitoring ensures that program effects are within the limits of the evaluated or anticipated take in the selected alternative. Monitoring involves review of the EA for all of the issues evaluated in Chapter 3 and 4 to ensure that the activities and associated impacts have not changed substantially over time.

1.7 AGENCIES INVOLVED IN THIS EA AND THEIR ROLES AND AUTHORITIES

1.7.1 USDA WILDLIFE SERVICES

The primary statutory authority for the APHIS-WS program is the Act of March 2, 1931, as amended (7 U.S.C. § 426-426b), which provides that:

The Secretary of Agriculture is authorized and directed to conduct such investigations, experiments, and tests as he may deem necessary in order to determine, demonstrate, and promulgate the best methods of eradication, suppression, or bringing under control on national forests and other areas of the public domain as well as on State, Territory or privately owned lands of mountain lions, wolves, coyotes, bobcats, prairie dogs, gophers, ground squirrels, jackrabbits, brown tree snakes and other animals injurious to agriculture, horticulture, forestry, animal husbandry, wild game animals, furbearing animals, and birds, and for the protection of stock and other domestic animals through the suppression of rabies and tularemia in predatory or other wild animals; and to conduct campaigns for the destruction or control of such animals. Provided that in carrying out the provisions of this Section, the Secretary of Agriculture may cooperate with States, individuals, and public and private agencies, organizations, and institutions.

Since 1931, with changes in societal values, APHIS-WS policies and programs place greater emphasis on the part of the Act discussing "bringing (damage) under control," rather than "eradication" and "suppression" of wildlife populations. In 1988, Congress strengthened the legislative authority of APHIS-WS with the Rural Development, Agriculture, and Related Agencies Appropriations Act (Public Law 100-202, Dec. 22, 1987. Stat. 1329-1331 (7 U.S.C. § 426c)). This Act states, in part:

That hereafter, the Secretary of Agriculture is authorized, except for urban rodent control, to conduct activities and to enter into agreements with States, 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 any 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.

APHIS-WS is a cooperatively-funded, service-oriented federal agency that provides assistance to requesting public and private entities, and federal, State, county, local and tribal governments. APHIS-WS responds to requests for assistance when valued resources are lost, damaged or threatened by wildlife. Responses can be in the form of providing technical assistance or direct PDM. The degree of AHIS-WS' involvement varies, depending on the complexity of the wildlife problem and authorities.

The mission of the USDA, APHIS, WS program is to provide federal leadership in managing conflicts with wildlife. WS' mission, developed through its strategic planning process (APHIS-WS Directive 1.201), is: 1) *"to provide leadership in wildlife damage management in the protection of America's agricultural, industrial and natural resources, and 2) to safeguard public* *health and safety."* The WS Policy Manual[8] reflects this mission and provides guidance for engaging in WDM through:

A) Training of WDM professionals;
B) Development and improvement of strategies to reduce economic losses and threats to humans from wildlife;
C) Collection, evaluation and dissemination of management information;
D) Cooperative WDM programs;
E) Informing and educating the public on how to reduce wildlife damage; and
F) Providing technical advice and a source for limited-use management materials and equipment such as pesticides, cage traps and pyrotechnics.

The APHIS-WS Policy Manual reflects the mission and provides guidance for engaging in PDM activities. APHIS-WS personnel abide by APHIS-WS mission and national policies. APHIS-WS activities are conducted in accordance with applicable federal, state and local laws. Prior to PDM being conducted, documents are prepared to engage in PDM activities. Documents can be an Agreement for Control, which is signed by the applicable WS State Office and the land owner or manager; a cooperative service agreement developed and signed; an Annual Work Plan (AWP) is prepared and provided to the land management administrator or agency representative for their review; or MOUs are developed between WS and other agencies at the local and national levels. These documents establish the need for the requested work, legal authorities allowing the requested work, and the responsibilities of APHIS-WS, WS-Utah, and its cooperators.

1.7.1.1 What Are the Roles of USDA APHIS Wildlife Services in WDM?

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, 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.

The APHIS-WS mission is broad, and includes resolution of wildlife conflicts in rural and urban areas; conservation of natural resources (including T&E 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 success is based in its paired programs 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

8 WS' Policy Manual provides guidance for WS personnel to conduct wildlife damage management activities through Program Directives. WS Directives referenced in this EA can be found in the manual but will not be referenced as Literature Cited in Appendix A.

operations personnel and NWRC researchers work closely together. This ensures that APHIS-WS will continue to resolve wildlife conflicts effectively and as humanely as possible, using advanced science and technology. NWRC applies scientific expertise to the development of practical methods to resolve these problems and to maintain the quality of the environments shared with wildlife. The Center designs studies to ensure that the methods developed to alleviate animal damage are biologically sound, effective, safe, 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, NWRC provides valuable data and expertise to the public and the scientific community, as well as to APHIS-WS' operational program.

1.7.1.2 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. 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."*

1.7.1.3 What Are APHIS-WS' and WS-Utah's Mission, Goals, and Objectives?

The APHIS-WS mission, discussed above, is to provide professional federal leadership in improving the coexistence of people and wildlife. 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. To facilitate long-term strategic planning, APHIS-WS identified a list of core program functions in the APHIS-WS 2013-2017 Strategic Plan (APHIS-WS 2013), including these functions relevant to WS-Utah:

A) Predation management for the protection of wildlife;
B) Protection of natural resources (including threatened and endangered species) from other injurious wildlife

C) Protection of agricultural resources and property from wildlife damage
D) Airport wildlife hazard management
E) Conducting wildlife damage research

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

Directive 3.101 states:

> "*APHIS-WS is specifically authorized to enter into cooperative programs with Government agencies, public or private institutions, organizations associations or private citizens to manage conflicts with wild animals. By coordinating Federal Government involvement in managing wildlife conflicts and/or damage, WS officials help ensure that wildlife management activities are environmentally sound and conducted in compliance with applicable Federal, State, and local laws and regulations, including two significant environmental laws, the Endangered Species Act and the National Environmental Policy Act (NEPA).*
>
> *Wildlife Services' successes in developing and providing its expertise in WDM methodologies and strategies have increasingly created methodologies, strategies, and opportunities for private industry to provide similar WDM services. WS activities are differentiated from commercial WDM activities by among other things, adherences to the environmental protection requirements promulgated under NEPA. In accordance with NEPA, WS evaluates and considers the environmental consequences of its proposed actions. WS may implement methods approved exclusively for WS personnel who are the only individuals, public or private, that are trained and certified in their use. WS cooperates with private businesses by 1) providing technical training at State, regional, and national conferences; 2) developing certain WDM methods and registering certain chemical or pesticide WDM products for use by the industry and the public, and 3) assisting businesses by applying WS-specific management methods when requested.*"

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. The goal of WS-Utah 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) 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. 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.

APHIS-WS activities are conducted in accordance with applicable federal, state, and local laws, work initiation documents, cooperative agreements, agreements for control, MOUs, and other applicable agreements and requirements, and the directives found in the WS Program Policy

Manual. These documents establish the need for requested work, legal authorities allowing the requested work, and the respective responsibilities of APHIS-WS and its cooperators.

1.7.1.4 Utah Wildlife Services Program

The WS-Utah program is a cooperative effort between WS-Utah and UDAF. The state authority for the program is found in Title 4, Chapter 23 Utah Code Annotated. Under that code, the State has created the Agricultural and Wildlife Damage Prevention Board (AWDPB), a nine member board that oversees the State role in PDM and the cooperative relationship between the State and WS-Utah. State employees receive state-issued paychecks and benefits and drive state-owned vehicles. Two fixed-wing aircraft are State-owned property and the State contracts for both fixed wing and helicopter services. Currently, WS-Utah is 45% state funded, 43% comes from federally appropriated funds, 8% from private cooperative funding, and 6% federal cooperative funds. For FY12 to FY16, 87% of WS-Utah work tasks were associated with PDM and 13% of the work tasks for other WDM; during this time 65% of the work tasks were for protecting agriculture (mostly livestock), 23% for natural resource protection (mostly other wildlife including T&E species), 10% for human health and safety protection (primarily airports and disease monitoring), and 2% for the protection of property.

The WS-Utah objectives are to:

- Professionally and proficiently respond to all reported and verified losses or threats due to predators using an IPDM approach following the APHIS-WS decision model (APHIS-WS Directive 2.201). IPDM must be consistent with all applicable federal, state, and local laws, APHIS-WS policies and directives, cooperative agreements, MOUs, and other requirements as provided in any decision resulting from this EA.
- Implement IPDM so that cumulative effects do not negatively affect the viability of any native predator populations.
- Ensure that actions conducted under an IPDM 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 nontarget effects by selecting the most effective, target-specific, and humane method(s) to resolve a predator problem, given legal, environmental, and other constraints.
- Incorporate the use of appropriate and effective new and existing lethal and nonlethal technologies, where appropriate, into technical and direct assistance strategies.

AWDPB has the option, at any time, of dissolving the cooperative program and implementing an entirely state-run program. Restrictions on the APHIS program within the Grand Staircase/Escalante National Monument (GSENM) led to the development of state policy directing predation management within the GSENM as a State project. While the State has the resources, personnel, and authority to conduct their own program, which they have done in the past, this EA analyzes the combined efforts under federal supervision of the cooperative program.

1.7.2 UTAH AGRICULTRAL AND WILDLIFE DAMAGE PREVENTION BOARD (AWDPB)

*Utah Statute 4-23-4 e*stablished AWDPB. AWDPB is comprised of the UDAF Commissioner serving as chairman, the UDWR Director serving as vice chairman, and seven other members appointed by the governor to four-year terms of office, which includes: (a) a sheep producer representing Utah wool growers; (b) a cattle producer representing Utah range cattle producers; (c) an agricultural landowner representing agricultural landowners of the state; (d) a person representing wildlife interests in the state; (e) a USDA employee; (f) a USFS employee; and (g) a BLM employee. The board is responsible for the formulation of the agricultural and wildlife damage prevention policy of the state and in conjunction with its responsibility may, consistent with Title 63G, Chapter 3, Utah Administrative Rulemaking Act, adopt rules to implement its policy, which shall be administered by the Department. In its policy deliberations, the board shall specify programs designed to prevent damage to livestock, poultry, and agricultural crops; and specify methods for the prevention of damage and for the selective control of predators, depredating birds, and other animals including hunting, trapping, chemical toxicants, and the use of aircraft. The board may also specify bounties on designated predatory animals and recommend to UDAF other actions it considers advisable for the enforcement of its policies. The board may also cooperate with federal, state, and local governments, educational institutions, and private persons or organizations, through agreement or otherwise, to effectuate its policies (Utah Code Annotated. Title 4. Utah Agricultural Code. Chapter 23. Agricultural and Wildlife Damage Prevention Act).

1.7.3 UTAH DEPARTMENT OF AGRRICULTURE AND FOOD (UDAF)

The Legislature finds and declares that it is important to the economy of the state to maintain agricultural production at its highest possible level and at the same time, to promote, to protect, and preserve the wildlife resources of the state. (Utah Code Annotated 4-23-2.) Under the provisions of Utah Code Annotated. Title 4. Utah Agricultural Code. Chapter 23), the Commissioner of Agriculture is responsible for administration of PDM activities in the state and for the issuance of private aerial hunting permits for PDM. Prevention and control of damage caused by some predatory big game and furbearer species, and unprotected and predatory wildlife is the responsibility of the UDAF. That responsibility is delegated to WS-Utah in an MOU dated February 3, 2011.

1.7.4 UTAH DIVISION OF WILDLIFE RESOURCES (UDWR)

In Utah, the management of all wildlife species, with the exception of federally listed T&E species, most migratory birds, and eagles, is the responsibility of the UDWR (Wildlife Resources Code of

Utah, Utah Code Annotated. Title 4, Chapter 23). However, UDAF has responsibility for prevention and control of some predatory big game species and furbearers, and unprotected species. UDWR also manages several types of wildlife management area's (WMA's), for waterfowl, upland, and big game species, WS-Utah coordinates with local DWR biologist each year throughout the state to conduct PDM on these WMA's for wildlife protection and recruitment. The majority of this work is conducted in the spring during breeding and nesting seasons. WS-Utah also coordinates with the UDWR on special projects as requested. These projects may help remove specific animals to help prevent the spread of disease, or remove predatory wildlife to reduce predation on recently translocated species. The UDWR is responsible to assess claims of livestock loss by bear, mountain lion, wolf and eagles in coordination with WS-Utah and UDAF (Utah Code Sections 23-14-14.1 and 23-24-1).

1.7.5 U.S. FISH AND WILDLIFE SERVICE (USFWS)

The management of T&E and migratory birds is USFWS responsibility. WS-Utah consults with USFWS on its potential program effects on T&E species from WDM activities. No action occurs without either a determination that the program would have no effect on T&E species, a concurrence from USFWS that the program would not be likely to adversely affect T&E species or a USFWS formal Biological or Conference Opinion with reasonable and prudent measures, if necessary, to ensure that WS-Utah would not jeopardize the continued existence of T&E species in Utah. WS-Utah routinely works with USFWS for the protection from predators of species under their jurisdiction such as black-footed ferrets, and during the Section 7 process under the Endangered Species Act. From 2014-2017, WS-Utah consulted with the USFWS Salt lake city office to review the WS-Utah PDM program statewide and any potential impacts it may have on T&E species in Utah. On April 5, 2017 the WS-Utah Biological assessment was signed by the USFWS, and was concurred that WS-Utah PDM would have **No effect**; **May effect, but not likely to adversely affect**; **Not likely to adversely affect**; and **Not Likely to Jeopardize** 45 T&E species.

1.7.6 U.S. FOREST SERVICE (USFS) AND BUREAU OF LAND MANAGEMENT (BLM)

USFS and BLM have the responsibility to manage the resources of federal National Forests and public lands for multiple-use including livestock grazing, timber production, recreation, and wildlife habitat, while recognizing the State's authority to manage resident wildlife populations. Both USFS and BLM recognize the importance of reducing wildlife damage on lands and resources under their jurisdictions, as integrated with their multiple-use responsibilities. For these reasons, both agencies have entered into National MOUs (BLM MOU WO-230-2012-05; FS MOU 11-SU- 11132422-151) with APHIS-WS to facilitate a cooperative relationship. Both federal land management agencies recognize the expertise of APHIS-WS in WDM and rely on APHIS-WS at the State-level to determine livestock and other resource losses and the appropriate methodologies for conducting PDM. In addition, WS-Utah has a state specific MOU with the BLM, Forest Service, State Institutional Trust Lands Administration, UDWR, and UDAF. WS-Utah PDM activities are conducted in compliance with USFS and BLM Land Use Plans, Travel Management Plans and the Federal Land Policy Management Act (Public Law 94-579) and other federal regulations.

1.8 LAWS RELATED TO WS-UTAH PDM

There are several federal laws, policies and Executive Orders that authorize, regulate or otherwise affect WS-Utah PDM activities. WS-Utah complies with these authorities and consults and cooperates with other agencies as appropriate

1.8.1 National Environmental Policy Act (NEPA) (42 U.S.C. §§ 4321 et seq.)

NEPA incorporates environmental planning and public involvement into federal agency planning and decision-making processes. Unless an action is exempt from compliance with NEPA, agencies must have available and fully consider detailed information regarding the potential environmental effects of their actions when a management decision is made and agencies must make this information available to interested or affected persons, agencies and organizations before decisions are made and actions are taken. WS, including WS-Utah, follows the Council for Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500 *et seq.*), as well as USDA (7 CFR 1b) and the APHIS NEPA implementing regulations (7 CFR Part 372), in the decision-making process. NEPA sets forth the requirement that all major federal actions be evaluated in terms of their potential to significantly affect the quality of the human environment.

Pursuant to NEPA and CEQ regulations, this EA documents the analysis of impacts from a proposed federal action, 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 NEPA are infused into federal agency actions. This EA was prepared by integrating as many of the natural and social sciences as warranted based on the potential effects of the proposed action. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

1.8.2 Migratory Bird Treaty Act of 1918(16 U.S.C. §§ 703-711), as Amended

The Migratory Bird Treaty Act provides the USFWS regulatory authority to protect species of birds that migrate outside the United States and prohibits any take of such birds except as permitted by the USFWS. WS-Utah receives annual authorization from the USFWS to take migratory birds that are causing damage or depredation problems. Executive Order 13186 and the subsequent MOUs between FWS and federal agencies provide additional measures for strengthening the conservation of migratory birds.

1.8.3 Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668c)

In addition to the protections afforded by the Migratory Bird Treaty Act, this law provides further protection for bald and golden eagles. Similar to the Migratory Bird Treaty Act, it prohibits any "*take*" of these species, except as permitted by the USFWS. The Act, through a USFWS permitting process (50 CFR 22.26), authorizes take of bald and golden eagles where it is compatible with the preservation of eagles; necessary to protect an interest in a particular locality; associated with but not the purpose of the activity; and where the take cannot practicably be avoided or is unavoidable even though advanced conservation practices are being implemented.

1.8.4 Endangered Species Act (ESA)

The ESA requires that all federal agencies seek to conserve T&E species and utilize their authorities in furtherance of the purposes of the Act (Section 2(c)). WS-Utah conducts consultations with the USFWS, as required by Section 7 of the ESA, to use the expertise and experience 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 species or threatened species."* (Sec. 7(a)(2)). WS-Utah entered into informal consultation with USFWS under Section 7 of the ESA for all WS-Utah wildlife PDM activities. WS-Utah will complete the consultation process with USFWS and include any necessary/new SOPs into the PDM program.

1.8.5 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA requires the registration, classification, and regulation of all pesticides used in the United States. All pesticides used or recommended by WS-Utah are registered with and regulated by the U.S. Environmental Protection Agency (USEPA) and UDAF. All pesticide use by WS-Utah is carried out in compliance to labeling procedures and requirements as regulated by USEPA and UDAF.

1.8.6 Fish and Wildlife Act of 1956 (16 U.S.C. § 742j-1), Airborne Hunting

This Act, amended in 1971, was added to the Fish and Wildlife Act of 1956 and is commonly referred to as the Airborne Hunting Act. The Act allows the following exemption to the general prohibition against the shooting of wildlife from an aircraft: "*This section shall not apply to any person if such person is employed by, or is an authorized agent of or is operating under a license or permit of, any State or the United States to administer or protect or aid in the administration or protection of land, water, wildlife, livestock, domesticated animals, human life, or crops, and each such person so operating under a license or permit shall report to the applicable issuing* *authority each calendar quarter the number and type of animals so taken*." USFWS regulates the Airborne Hunting Act but has delegated implementation to the States. In Utah, UDAF issues permits to private individuals for aerial hunting. WS-Utah is not required to be permitted by UDAF or federal law (16 U.S.C. § 742j-1) before conducting aerial PDM activities.

1.8.7 National Historic Preservation Act of 1966, as Amended (NHPA)

The NHPA (16 U.S.C. § 470), as amended, and its implementing regulations (CFR 36, 800) require federal agencies to: 1) determine whether proposed activities constitute "undertakings" that can result in changes in the character or use of historic properties; 2) if so, to evaluate the effects of such undertakings on such historic resources and consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological and historic resources; and 3) consult with appropriate American Indian tribes to determine whether they have concerns for traditional cultural properties in areas of these federal undertakings.

1.8.8 The Wild Horse and Burro Act of 1971

The Wild Horse and Burro Act of 1971 (Public Law 92-195), as amended by The Federal Land Policy and Management Act of 1996 (Public Law 94-579), and The Public Rangelands Improvement Act of 1978 (Public Law 95-514) requires BLM and USFS to manage wild horse and burro herds at population levels that preserve and maintain a thriving natural ecological balance on areas that they roam.

1.8.9 Executive Order 13186 and MOU between USFWS and APHIS

Executive Order 13186 directs agencies to protect migratory birds and strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and minimize the take of migratory birds through enhanced collaboration between agencies and indigenous tribes. A National-level MOU between the USFWS and APHIS was completed August 2, 2012, to facilitate the implementation of Executive Order 13186.

1.8.10 Executive Order 13175 - Consultation and Coordination with Indian Tribal Governments

The United States has a unique legal relationship with Indian tribal governments as set forth in the Constitution of the United States, treaties, statutes, Executive Orders and court decisions. Executive Order 13175 directs federal agencies to establish regular and meaningful consultation and collaboration with tribal officials in the development of federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes and to reduce the imposition of unfunded mandates upon Indian tribes. Agencies shall respect Indian tribal self-government and sovereignty, honor tribal treaty and other rights and strive to meet the responsibilities that arise from the unique legal relationship between the federal government and Indian tribal governments. This Executive Order directs 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. APHIS Directive 1040.3, Consultation with Elected Leaders of Federally Recognized Indian Tribes, provides guidance to APHIS programs on implementation of Executive Order 13175.

1.8.11 Native American Graves Protection and Repatriation Act

The Native American Graves and Repatriation Act of 1990 provides protection of American Indian 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 American Indian burials discovered on State and private lands. If a burial site is located by a WS-Utah employee, the appropriate tribe would be notified. PDM activities on tribal lands are only conducted at the request of a tribe and, therefore, the tribe would have ample opportunity to discuss cultural and archeological concerns with WS-Utah.

1.8.12 The Wilderness Act (16 U.S.C. §§ 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 (WAs) are devoted to the public for recreational, scenic, scientific, educational, conservation and historical use. Section 4(d)(4)(2)(4) - Water Resources and Grazing states, "*Within wilderness areas in the national forests designated by this Act, ... (2) the grazing of livestock, where established prior to September 3, 1964, shall be permitted to continue subject to such reasonable regulations as are deemed necessary by the Secretary of Agriculture*." The Act leaves management authority for fish and wildlife in WAs with the State for those species under their jurisdiction. Some portions of WAs in Utah have historic grazing allotments and permittees could request WS-Utah assistance with PDM. As future requests are received to conduct PDM in WAs, WS-Utah will continue to consult with the appropriate federal land management agency to ensure activities are in compliance with the Act.

1.8.13 Environmental Justice and Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Environmental Justice has been defined as the pursuit of equal justice and equal protection under the law for all environmental statutes and regulations without discrimination based on race, ethnicity or socioeconomic status. Executive Order 12898 requires federal agencies to make Environmental Justice part of their mission and to identify and address disproportionately high and adverse human health and environmental effects of federal programs, policies and activities on minority and low- income persons or populations. A critical goal of Executive Order 12898 is to improve the scientific basis for decision-making by conducting assessments that identify and prioritize environmental health risks and procedures for risk reduction. Environmental Justice is a priority within USDA, APHIS, and WS. APHIS plans to implement Executive Order 12898 principally through its compliance with the provisions of NEPA.

WS-Utah activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice and implement PDM methods as selectively and environmentally conscientiously as possible. All chemicals used by WS-Utah are regulated by USEPA through FIFRA, UDAF, by MOUs with federal land management agencies and by WS Directives. WS-Utah properly disposes of any excess solid or hazardous waste. 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.

1.8.14 Executive Order 13045 "Protection of Children"

Children may suffer disproportionately from environmental health and safety risks, including their developmental physical and mental status, for many reasons. APHIS-WS policy is to identify and assess environmental health and safety risks and avoid or minimize them, and WS-Utah has considered the impacts that alternatives analyzed in this EA might have on children. All WS-Utah PDM is conducted using only legally available and approved damage management methods where it is highly unlikely that children would be adversely affected. See Appendix E for a detailed description of all damage management methodologies included in the WS-Utah program and Chapter 4 for an analysis of their impacts.

1.8.15 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. The management of wildlife populations and even individual wild animals is under the legal jurisdiction of state wildlife agencies, USFWS for ESA-listed species, migratory birds including eagles, and bats, and tribal governments for species on tribal lands. Each state has full authority and jurisdiction to manage native wildlife within its boundaries, unless authority is granted to another governmental entity, such as USFWS per the ESA, the Migratory Bird Treaty Act, or the Bald and Golden Eagle Protection Act. In Utah, most native wildlife species are managed by UDWR. APHIS-WS defers to the applicable laws set by these agencies as applicable to particular actions.

APHIS-WS has no authority to determine national policy regarding use and commitment of local, state, tribal, or federal resources or lands for economic use by private entities such as livestock grazing or timber growth and harvest, nor use of private land such as for livestock feedlots, or government, commercial, or residential development. APHIS-WS does not make public land use 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 BLM, and the Forest Service Organic Act of 1897 and the Multiple Use-Sustained Yield Act of 1960 for USFS. Congressional appropriations support the implementation of these authorities. In contrast, WS-Utah only addresses WDM upon request (WS Directive 2.201).

WS-Utah cannot use pesticides unless they are approved by USEPA per FIFRA and are registered for use in Utah with UDAF. WS-Utah must ensure that all storage, use, and disposal by WS-Utah personnel is consistent with FIFRA label requirements and WS Directive 2.401.

For more details on the various federal and state laws regarding wildlife management and protection, see Appendix F.

1.9 RELATIONSHIP OF THIS EA TO OTHER ENVIRONMENTAL DOCUMENTS

Predator Damage Management in the Southern and Northern WS-Utah District EA's. WS-Utah prepared two EA's in 1996 and issue a FONSI and signed a Decision in 1997 for the documents. The EA's were developed cooperatively with state and federal agencies and assessed direct, indirect and cumulative impact on the quality of the human environment. These EAs and FONSIs are superseded by this EA.

Predator Damage Management in the Southern WS-Utah District EA. WS-Utah developed a draft EA for the Utah Southern District that contained WS-Utah data from FY99 through FY04, and provided that EA to the public for a 30-day comment period in 2006. The 2006 EA is superseded by this EA.

National Forest Land and Resource Management Plans (LRMPs). The National Forest Management Act requires that each National Forest prepare a Land and Resource Management Plan (LRMP) for guiding long range management and direction. During the work plan development process, WS-Utah coordinates with each National Forest to address pertinent issues related to PDM on National Forest System administered lands and to avoid cumulative impacts.

BLM Resource Management Plans (RMP) and Management Framework Plans (MFPs). The BLM currently uses RMPs to guide management on lands they administer. RMPs generally replace older land use plans known as MFPs. During the work plan development process, WS-Utah coordinates with each BLM Field Office to address pertinent issues related to PDM on BLM administered lands and to avoid cumulative impacts.

National Level MOUs with USFS and BLM. MOUs have been developed and signed between APHIS-WS and BLM (completed August 29, 2012) and between APHIS-WS and USFS (completed July 5, 2011) which coordinate WDM activities and related compliance with the National Environmental Policy Act on BLM and USFS lands.

Executive Order 13186 and MOU between USFWS and APHIS. This order directs agencies to protect migratory birds and strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and minimize the take of migratory birds through enhanced collaboration between agencies and Native American tribes. A National-level MOU between the USFWS and APHIS was completed August 2, 2012 to facilitate the implementation of Executive Order 13186

1.10 NEPA RELATED REQUIREMENTS AND ISSUES

NEPA is an administrative policy that was established to protect the environment from federal actions. Many requirements and issues arise that are related to this statute.

1.10.1 Interagency and Tribal Coordination for the EA and PDM

Public notification processes regarding the availability of the final NEPA document and decision will be identical to that used for the pre-decisional EA, with the addition of direct contact with commenters. Issues related to the proposed action have been historically developed by an interdisciplinary team process including USFWS, USFS, and BLM at the federal level, and UDAF, UDWR, and Utah School and Institutional Trust Lands Administration at the state level. Since PDM conducted by WS-Utah is ongoing, WS-Utah continually confers and communicates issues needing discussion or changes to PDM through annual and biannual meetings with an interagency team. The interagency team, the “Multi-Agency Team,” which includes WS-Utah, USFS, BLM, UDWR and UDAF personnel, discusses arising issues or changes to PDM. These agencies are requested to provide input into the EA, especially as related to their area of expertise. Agency involvement can be provided as a cooperating and commenting agency, but the opportunity to comment on an internal interagency draft prior to public release is afforded.

A letter requesting tribal involvement in the EA is sent directly to all federally registered tribes within Utah. This includes the Confederate Tribes of the Goshute Reservation, the Navajo Nation, the Northwestern Band of Shoshoni Nation, the Paiute Indian Tribe of Utah (including the Cedar Band of Paiutes, Kanosh Band of Paiutes, Koosharem Band of Paiutes, Indian Peaks Band Of Paiutes, and Shivwits Band Of Paiutes), the Skull Valley Band of Goshute Indians of Utah, the Ute Indian Tribe of the Uintah and Ouray Reservation, and the Ute Mountain Ute Tribe. Many of these Tribes have an identified interest in WS-Utah projects.

1.10.2 Public Involvement in this EA

WS-Utah involves the public in its EA processes by providing for public comment on EAs prior to a Decision being made, and WS-Utah provides for a 30-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, or alternatives. Using the guidance provided in 40 CFR §1506.6 for public involvement, WS-Utah will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. A public involvement letter summarizing the proposed action of the EA, a website link to the EA, or address to request a hard copy, and a request for comments on the EA prior to a Decision being rendered is sent via a government website (regulations.gov) to several identified interested persons and organizations, which numbers in the many hundreds. Additionally, a "Notice of Availability" is posted in the Salt Lake Tribune, Utah's most circulated newspaper. The EA is typically available for comment through regulations.gov or directly emailing an email address provided for a 30-day or more comment period. Public notification processes regarding the availability of the final NEPA document and decision will be identical to that used for the pre-decisional EA, with the addition of direct contact with commenters.

1.10.3 Rationale for Preparing an EA Rather Than an EIS

The primary purpose of an EA is to determine if impacts from the proposed action or alternatives might be significant and, if so, WS-Utah can make an informed decision on whether or not an EIS is required for the WS-Utah PDM activities included in this EA (40 CFR 1508.9(a)(3) and 40 CFR 1501.4). This EA also facilitates planning and interagency coordination, streamlines informed decision-making, and provides for timely and effective responses to requests for PDM assistance. WS-Utah also prepared this statewide EA for its PDM activities to clearly communicate the analysis of individual and cumulative impacts of its actions to the public using guidance at 40 CFR §1506.6. In order to make this decision, this EA conducts a thorough analysis of direct, indirect, and cumulative impacts associated with WS-Utah assistance to requesting entities in managing predator damage and threats to resources and assets, and threats to human safety and health. WS-Utah addresses all anticipated issues and reasonable alternatives in this EA. If WS-Utah 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-Utah would 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)).

This EA includes thorough and comprehensive analyses of the impacts and effectiveness of four alternative PDM programs in Utah, including no WS-Utah activities at all, 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-Utah activities and alternatives in detail, and provides rationale for not considering other alternatives and issues in detail.

This EA emphasizes substantive issues as they relate to specific areas whenever possible. However, the issues that pertain to predator damage and resulting management are the same, for the most part, wherever they occur, and are treated as such. We have determined that a more detailed and more site-specific level of analysis would not substantially improve the decision-making process and pursuing a more site-specific and more detailed analysis might even be considered inconsistent with NEPA's emphasis on reducing unnecessary paperwork (Eccleston 1995).

In terms of considering cumulative effects, one EA analyzing impacts for the entire State of Utah would provide a more comprehensive and less redundant analysis than multiple EAs covering smaller areas. WS-Utah determination to prepare an EA is consistent with APHIS NEPA implementing regulations (7 CFR Part 372) specifying the types of actions normally requiring EAs but not necessarily EISs.

1.10.4 How will WS-Utah Evaluate Significant Impacts

The process for determining if a project or program may have significant impacts is based on the CEQ regulations at 40 CFR §1508.27. WS-Utah will review the impacts evaluated in Chapter 4 of this EA in two ways: 1) The severity or magnitude of the impact on a resource; and 2) the context of the impact. For example, context may be considered when the resource is rare, vulnerable, not resilient, or readily changed in the long-term even after a short-term stressor. Most of the factors included in 40 CFR §1508.27(b) include the phrase "*the degree to which*" a particular type of resource might be adversely impacted. Therefore, WS-Utah evaluates the impacts to resources and documents the predicted effects in this EA. These effect analyses are used to determine if the levels of impact are indeed "significant" impacts for which a FONSI would not be appropriate rather an EIS would be preapred. If WS-Utah determines that the levels of impacts are not significant, then, per CEQ regulations, the agency will document the rationale for not preparing an EIS in a publicly available FONSI. The factors identified in 40 CFR §1508.27 are not checklists, nor do they identify thresholds of impacts; they are factors for consideration by the agency while making the decision regarding whether to prepare a FONSI based on the impact analyses in an EA or an EIS. The agency will determine how to consider those factors in its determination to prepare a FONSI or an EIS. WS-Utah will determine the *degree* to which a factor applies or does not apply to the impacts documented in this EA.

The following sections outline how WS-Utah will use this EA and the criteria from 40 CFR §1508.27 determine whether an EA or an EIS is appropriate for the WS-Utah PDM program.

1.10.4.1 Controversy Regarding Effects

The factor at 40 CFR §1508.27(b)(4) is described as "*the degree to which the effects on the quality of the human environment are likely to be highly controversial*." 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 or substantial doubts raised about an agency's methodology and data, is not enough to make an action "controversial." This EA evaluates peer-reviewed and other appropriate published literature, reports, and data from agencies with jurisdiction by law to conduct the impact analyses and evaluate the potential for significant impacts. This EA also includes and evaluates differing professional opinions and recommendations expressed in publications where they exist and that are applicable to APHIS-WS informed decision-making.

A relatively recent comment raised by the public in response to APHIS-WS PDM EAs in the western United States suggests that scientific controversy exists regarding APHIS-WS removal of predators considered to be at the top of the ecological food chain ("apex predators") that can cause "trophic cascades" resulting in reductions in biodiversity. This comment argues that changes at the top of the food chain (such as wolves) may result in ecological changes, including releases of populations of smaller predators (such as coyotes or foxes), in which other, often smaller predator populations may be released from suppression caused by larger predators. Commenters also often express concern about the perception of the humaneness of lethal and nonlethal operational methods used by WS-Utah personnel. These issues are considered in detail using the best scientific and professional wildlife management and biology information as well as veterinarian literature available in Chapter 4. APHIS-WS recognizes that people may readily disagree on the subjective analysis of the degree to which these issues are impacted from a personal standpoint, but the science behind these issues is not controversial, the key to determining scientific controversy for an issue.

1.10.4.2 Unique or Unknown Risks

Another concern commonly expressed in comments involves the potential for unknown or unavailable information (40 CFR §1502.22) to potentially result in uncertain or unique or unknown risks (40 CFR §1508.17(b)(5)), especially related to population numbers and trends and the extent and causes of mortality of target and nontarget species. Throughout the analyses in Chapter 4 of this EA, WS-Utah uses the best available data and information from wildlife agencies having jurisdiction by law (UDWR,UDAF, and USFWS; 40 CFR §1508.15), as well as the scientific literature, especially peer-reviewed scientific literature, to inform its decision-making. Data provided by livestock producers, especially regarding the economic value of livestock lost to predation as reported for inclusion in the APHIS-WS MIS database, is inherently subjective to some degree, and is therefore used only as an indicator for the costs associated with livestock depredation.

Population and mortality data for many native target species (Chapter 4.3.1.1-4.3.1.7), such as coyotes, red foxes, raccoons, badgers, and striped skunks, are typically non-existent from any credible source, in or outside of Utah. WS-Utah recognizes that estimating wildlife populations over large areas can be extremely difficult, labor intensive, and expensive. UDWR, or, for that matter, any state wildlife management agency, has limited resources for estimating population levels and trends for predator species that are not managed as game or furbearers. Therefore, these state agencies do not directly set population management objectives for these species. States may choose to monitor population health using factors such as sex ratios, age distribution of the population, indices of abundance, or trend data to evaluate the status of populations that do not have direct population data. This EA uses the best available information from wildlife management agencies, including UDWR when available, and peer-reviewed literature to assess potential impacts to predator and nontarget wildlife species.

If population estimates are available, then the analyses in Chapter 4 use the lowest density or number estimates for wildlife species populations (where high and low population estimates are provided in the text) to arrive at the most conservative impact analysis. Coordination with UDWR and USFWS, and providing the opportunity for agency review of and involvement in this EA ensure that analyses are as robust as is possible. The analyses in Chapter 4 provide information for WS-Utah to determine if WS-Utah contribution to cumulative mortality from all sources would adversely affect population levels for each predator species considered in this EA.

1.10.4.3 T&E Species, Unique Geographic Areas, Cultural Resources, and Compliance with Environmental Law

This EA also provides analyses and documentation related to T&E species (Section 4.4), areas with special designations such as wilderness areas (Section 2.3.3), cultural and historic resources Sections 2.4 and 4.5), and compliance with other environmental laws, including state laws (Sectio 1.8). This will be used to address the significance criteria at 40 CFR §1508.27(b)(3, 8, 9, and 10).

1.10.4.4 Cumulatively Significant Impacts

Another common comment involves the criterion for the analysis of "cumulatively significant impacts" (40 CFR §1508.27(b)(7)), which is considered in this EA in various ways. Many of the issues evaluated in detail are inherently cumulative impact analyses including, such as CH 4. This EA considers cumulative impacts as available. However, some will be the same for all the alternatives as they are impacts that are occurring regardless of impacts from WS-Utah PDM such as population reduction due to decreased habitat availability from development. This EA considers WS-Utah take in relation to all other known sources of mortality for animals including the following.

- Impacts to target species' populations, as each population has many sources of mortality, only one of which is take by WS-Utah;
- Impacts to nontarget species' populations, as each population has many sources of mortality, loss of habitat, climate change, and/or other stressors, and only one source of mortality is take by WS-Utah;
- Impacts to populations of ESA-listed species, as these species' populations are already cumulatively impacted by many sources of mortality, loss of habitat, climate change, and other stressors, causing them to be listed;
- Potential ecological impacts caused by removal of apex predators, as many ecological factors contribute to any resulting impacts; and

Potential for lead from ammunition to impact environmental and human factors, as there are many sources of lead in the environment, including lead from hunting activities and ingesting game meat shot with lead ammunition, and lead may chronically enter the environment and people over time.

1.10.4.5 Public and Employee Health and Safety

The concern regarding public health and safety (significance criterion at 40 CFR §1508.27(b)(2)) is evaluated in several analyses in this EA such as:

- The potential for humans to ingest lead sourced from ammunition through water and game meat (Sections 4.6.6);
- The potential for hazardous chemicals being spilled or leached into surface and groundwater, and being ingested by humans (Section 4.6.7);
- The risk of injury to WS-Utah employees during aerial PDM operations (Sections 2.3.4 and 4.6.4); and The risk of injury to WS-Utah employees while handling hazardous chemicals, being exposed to diseased animals, and the risk of attack by captured animals (Section 4.6.7).

1.10.4.6 Impacts Can Be both Beneficial and Adverse

Some commenters may believe that, because the protection of human and pet health and safety, livestock and other property, and wildlife is extremely beneficial, an EIS must be prepared, based on 40 CFR §1508.27(b)(1). It is important that beneficial outcomes and effects be identified as well as adverse effects as contributions to informed decision-making. This EA describes the various needs to which WS-Utah responds when requested, and evaluates the impacts associated with PDM actions in Chapter 4.

1.10.4.7 Environmental Status Quo

As defined by NEPA implementing 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). Therefore, when a federal action agency analyzes its potential impacts on the "human environment," it is reasonable for that agency to compare not only the effects of the federal action, but also the potential impacts that occur or will occur in the absence of the federal action by a non-federal entity. This concept is applicable to situations involving federal assistance to reduce damage associated with wildlife species.

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 the baseline. Based on the existing human environment described above, and the numerous types of human relationships that are established components of that environment, the baseline appropriate to use for analysis in this EA is not a "pristine" or "non-human-influenced" environment, but one that is already heavily influenced by human actions and direct management. Another way to evaluate impacts of the federal action in this situation is to compare against the *status quo* for the human environment that would exist with no federal WS-Utah involvement in corrective PDM for conflict management purposes in Utah.

The PDM program in Utah is a very unique melding of state and federal resources, roles, responsibilities, and authorities. It is a collaborative program with active participants from three primary agencies, UDWR, UDAF, and WS-Utah. As per state statute 4-23 the UDWR and UDAF are responsible for controlling wildlife causing damage to personal property or endangering personal safety. Protocol established by the Utah State Legislature and approved by the Agricultural and Wildlife Damage Prevention Board sets forth policies and procedures to be followed in controlling and preventing wildlife damage and addressing public safety issues within the State of Utah. In carrying out these policies where wildlife/human interactions are involved UDWR and UDAF have the discretion to choose the most applicable management action, following the guidelines established by the AWDPB. In order to comply with this responsibility, UDWR and UDAF collaborate with USDA-APHIS-WS to manage offending wildlife which are causing or about to cause damage to livestock, wildlife resources, agricultural crops, or personal property and to protect the public from dangerous animals when it is warranted.

Without WS participating UDWR and UDAF would, by statute, carry out PDM with existing UDAF personnel. Currently the state program provides greater than 85 percent of the of the field personnel preforming the direct PDM operations, including their salaries, benefits, and vehicles. UDAF also provides a state owned and operated aircraft. UDAF also manages, processes, and maintains 11 state contracts for aerial predator control services. In addition, these employees are ultimately supervised and subject to UDAF rules and regulations. UDWR provides guidance for PDM activities under their purview, and through legislative funding and support provide an enormous proportion of the PDM funding used for wildlife protection within Utah.

WS-Utah provides additional technical expertise and training, day to day supervision and support of field staff, and collaborative office support for the existing state programs that already exist. In addition, WS-Utah provides federal aircraft and federal pilots for state requested PDM activities. WS-Utah provides collaboration and understanding between federal agencies. WS-APHIS provides some federal allocation of funding to support this cooperative and synergistic program.

Without Federal support, PDM activities will continue at a relatively high-level due to the need for services and already existing personnel from the state program. Technical assistance, training, daily supervision, and program oversight would again become the obligation of UDAF and UDWR. Aerial operations would continue without federal input of resources and would be supported by the existing 11 state helicopter contractors at a higher cost, and at less benefit to the citizens of the state.

1.11 What IS THE EFFECTIVENESS OF THE NATIONAL APHIS-WS PROGRAM

Effectiveness is based on many factors, especially attempting to meet the desired WDM objectives. Factors can include the types of methods used, the skill of the person using them, the percentage of time the target animal is caught, damage prevented, and cost of the operation while careful consideration is given to the implementation of the project under legal restrictions, best management practices, and any number of environmental constraints including weather, terrain, vegetation, and the presence or absence of humans, pets, and nontarget animals. To maximize effectiveness, field personnel must be able to consistently apply the APHIS-WS Decision Model (WS Directive 2.201) 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 nontarget 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). The purpose behind IWDM is to implement methods in the most effective manner while minimizing any potentially harmful effects on the human environment.

1.11.1 Consideration for Evaluating Program Effectiveness

APHIS-WS and professional wildlife managers acknowledge that a damage problem may return after a period of time regardless of the lethal or nonlethal strategies applied if the attractant conditions continue to exist at the location where damage occurred, the predator densities are sufficient to reoccupy available habitats with transient or juvenile animals, and 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 does not mean management strategies were not effective for addressing a particular event, but that periodic lethal or nonlethal 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.

The use of nonlethal methods described in Appendix E, such as harassment or frightening 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 a temporary solution if habitat conditions that attracted those predators to damage areas remain unchanged. Additionally, animals tend to habituate rapidly to frequent use of similar techniques. Therefore, both lethal and some nonlethal methods often result in the return of the same or new animals to the area, unless the conditions are changed or the animals are physically restrained from the area, such as by fencing.

A WS-Utah objective is to ensure that all PDM actions cumulatively would not cause adverse effects on statewide target predator populations, or on populations of nontarget species (Chapter 4.2.). Therefore, WS-Utah policy is not to cause population-wide or even localized long-term adverse impacts to native target species' populations, unless it is to meet UDWR management objectives, or any adverse impacts to populations of native nontarget species. Dispersing and relocating 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 relocated animal could return to its original trapping site. UDWR policy is to euthanize all captured coyotes and smaller abundant predator species and to never relocate problem animals, because of the healthy size of the populations statewide and the high risk of moving the problem along with the animal. These UDWR policies avoid causing damage problems in the receiving site, reduce the risk that the animal will return to its original home range, and avoid potentially causing the death of the animal due to occupied territories or unfamiliarity with the new location. Based on an evaluation of the damage situation using the APHIS-WS Decision Model, the most effective methods should be used individually or in combination based on experience, training, and sound wildlife management principles. The effectiveness of methods are evaluated on a case-by-case basis by the field employee as part of the decision-making process using the APHIS-WS Decision Model (WS Directive 2.201) for each PDM action and, where appropriate, field personnel follow-up with the cooperator.

An analysis of effectiveness of each of the WS-Utah alternatives considered in detail is found in Chapter 4. Additional considerations on effectiveness of PDM based on literature and how it relates to predator populations sustainability, mesopredator release, and ecosystem services is also found in Chapter 4.

1.11.2 Effectiveness of PDM Methods

Defining the effectiveness of any damage management activities often occurs in terms of losses or risks potentially reduced or prevented. Efficacy is based on the types of methods employed, the application of the method, restrictions on the use of the method(s), the skill of the personnel using the method and for WS-Utah's personnel, the guidance provided by APHIS-WS' directives and policies. Effectiveness can also be dependent upon how accurately practitioners diagnose the problem, the species responsible for the damage, and how people implement actions to correct or mitigate risks or damages. To determine that effectiveness, WS-Utah must be able to complete management actions expeditiously to minimize harm to nontarget animals and the environment, while at the same time, using methods as humanely as possible. The most effective approach to resolving any wildlife damage problem would be to use an adaptive integrated approach, IPDM, which may call for the use of several management methods simultaneously or sequentially (Courchamp et al. 2003). The purpose behind IPDM is to implement methods in the most effective manner while minimizing the potentially harmful effects on people, target and nontarget species and the environment[9].

The goal for all of the WS-Utah action alternatives would be to reduce damage, risks and conflicts with wildlife as requested and not to reduce/eliminate populations. Localized population reduction could be short-term with new individuals immigrating into the area or born to animals remaining at the site (Courchamp et al. 2003). The ability of an animal population to sustain a certain level

[9] The cost of management may sometimes be secondary because of overriding environmental, legal, human health and safety, animal welfare, or other concerns.

of removal and to return to pre-management levels eventually does not mean individual management actions were unsuccessful, but that periodic management may be necessary. The return of wildlife to pre-management levels also demonstrates that limited, localized damage management methods have minimal impacts on species' populations.

WS-Utah often receives comments that lethal methods would be ineffective because additional predators would likely return to the area. In addition, comments also claim that because predators return to an area after initial removal efforts are complete, the use of lethal methods gives the impression of creating a financial incentive to continue the use of only lethal methods. Those statements assume predators only return to an area where damage was occurring if WS-Utah used lethal methods. However, the use of many nonlethal methods are most often only temporary, which could result in predators returning to an area where damage was occurring once WS-Utah no longer used those methods or once an animal habituated to the method. The common factor when employing any method would be that predators would return if suitable conditions continued to exist at the location where damage was occurring and predator densities were sufficient to occupy all available habitats to the extent that damage occurs.

Impacts of any method that disperses or removes predators from areas are expected to only be temporary if habitat containing preferred habitat characteristics continued to exist. Dispersing predators using nonlethal methods addressed in Appendix E often requires repeated application to discourage those animals from returning to locations, which increases costs, moves animals to other areas where they could cause damage and would be temporary if habitat conditions that attracted those predators to damage areas remained unchanged. Some people could view dispersing or translocating predators, particularly animals that have learned to take advantage of resources associated with humans, as moving a problem from one area to another, which would require addressing damage caused by those predators at another location, thereby increasing costs and could be perceived as creating a financial incentive to continue the use of those methods since predators would have to be addressed annually and at multiple locations. WS-Utah recommendation of or use of techniques to modify existing habitat or make areas unattractive to predators is discussed in Appendix E. The objective of WS-Utah would be to respond to requests for assistance with the most effective methods and to provide for the long-term solution to the problem using APHIS-WS' Decision Model (WS Directive 2.201).

Managing damage caused by predators can be divided into short-term redistribution approaches and long-term population and habitat management approaches. Short-term approaches focus on redistribution and dispersal of predators to limit use of an area where damage or threats were occurring. Short-term redistribution approaches may include prohibiting feeding, the use of pyrotechnics, propane cannons, effigies and other adverse noise, erecting access barriers such as fencing, and repellents. Localized population reduction would also likely be a short-term solution, particularly for highly mobile species. Largescale population reduction by limiting survival or reproduction, removing animals and habitat modification would be considered a long-term solution to managing damage caused by wildlife, as would construction of fences and some types of habitat modification and cultural practices. Large-scale population reduction is rarely considered an acceptable or viable solution to conflicts with predators and WS-Utah generally uses a more targeted approach that focuses on individual animals or small local populations associated with specific conflicts.

Redistribution methods would often be employed to provide immediate resolution to damage occurring until long-term approaches can be implemented or have had time to reach the desired result. Dispersing predators can often be a short-term solution that moves those predators to other areas where damages or threats could occur. Some short-term methods may become less effective in resolving damage as a predator population increases, as predators become more acclimated to human activity, and as predators become habituated to harassment techniques. Nonlethal methods often require a constant presence at locations when predators were present and must be repeated every day or night until the desired results are achieved, which can increase the costs associated with those activities. Nonlethal methods may also require constant monitoring and maintenance to insure proper results. For example, fencing could be used to prevent access to a resource; however, constant monitoring of the fencing is required and necessary repairs completed to ensure the use of fencing would be successful in preventing access to resources. Long-term solutions to resolving predator damage often require management of the population or its habitat and identifying the habitat characteristics that attract predators to a particular location. Habitat management practices which may result in long-term resolution of damage problems are generally conducted by the landowner or manager who is responsible for ensuring that habitat management actions are conducted in accordance with applicable federal, State and local regulations for the protection of the environment.

Research has shown that in areas without some level of damage management, losses of adult sheep and lambs to predators can be as high as 8.4% and 29.3% of the total number of sheep, respectively (Henne 1975, Munoz 1977, O'Gara et al. 1983). Additional research has indicated that sheep and lamb losses are generally lower where PDM was applied (Nass 1977, Tigner and Larson 1977, Howard and Shaw 1978, Shaw 1987, Howard and Booth 1981). The effectiveness of damage management activities can also be measured by public satisfaction, Shwiff and Merrell (2004) reported a 5.4% increase in the numbers of calves brought to market when coyotes were removed by aerial operations. As discussed in Section 1.10.5, Bodenchuk et al. (2002) reported cost:benefit ratios of 1:3 to 1:27 for agricultural resource protection from predators. Wagner and Conover (1999) found that total lamb losses declined 25% on grazing allotments in which coyotes were removed by winter aerial operations five to six months ahead of summer sheep grazing. On allotments where no aerial operations occurred, total lamb losses only declined 6%. Confirmed losses to coyotes declined by 7% on allotments where aerial operation occurred, but increased 35% on allotments where no aerial operations occurred (Wagner and Conover 1999).
A recent study by Treves et al. (2016) criticizes certain research on lethal PDM methods and recommends suspension of these tools until more rigorous scientific studies prove their efficacy (Treves et al. 2016). The authors in this paper call for new study designs that use the same standards as those in controlled laboratory settings for biomedical research. NWRC research scientists have evaluated this paper and do not agree with the authors' assessment that existing research is flawed. 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 variability using well-established and recognized field study designs, such as the switch-back and paired block designs. Additionally, Treves et al.'s (2016) critique of at least two studies by scientists currently working for WS did

not accurately interpret or represent the designs of the studies or results, thus, raising questions regarding additional misrepresentations and errors in the paper. A review by WS of Treves et al. (2016) and additional details are provided in Appendix D.

APHIS-WS agrees that DPM tools and techniques must be based on rigorous, scientifically-sound principles. Researchers at WS-NWRC are dedicated to gathering information, testing new ideas and methods, and using trial experiments versus observational studies as much as possible. WS-NWRC scientists at Utah Field Station 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 their findings are published in peer-reviewed literature.

WS-Utah believes that this EA uses the best available information regarding the efficacy of PDM methods. No nonlethal or lethal method or group of methods are effective under all conditions. Consequently, this EA analyzes alternatives that provide access to many methods, which may be employed using an adaptive integrated PDM process. Due to site-specific variations in efficacy of methods, this process includes continuous evaluation of activities at each project site and adjustment of methods as needed to achieve management objectives while also minimizing environmental impacts. Therefore, the effectiveness of methods would be considered as part of the decision making-process under the use of the Decision Model (WS Directive 2.201) described for each damage management request based on the continual evaluation of methods and results and does not need to be addressed as a separate issue in detail.

1.11.3 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 (e.g., Lute and Attari 2016). For meeting various objectives, the government recently conducted two detailed audits of APHIS-WS PDM programs, including the effectiveness of PDM and compliance with federal and state laws and regulations. The audits found that the APHIS-WS PDM programs were both effective and cost-effective.

In FY 2014, the USDA Office of Inspector General (OIG), conducted a formal audit of the APHIS-WS WDM program (OIG 2015). The primary objective of the audit was to determine if WDM activities were justified and effective. The audit was conducted because the agency had received considerable media attention creating controversy among the general public, animal rights organizations, and conservation groups based on allegations of unsanctioned activities conducted by some of APHIS-WS field personnel. OIG had also received numerous hotline complaints and letters from the general public, and animal rights and environmental groups alleging the use of indiscriminant methods capturing nontarget species, animals not dying immediately with associated concerns about humaneness, especially those animals held in traps, and allegations that APHIS-WS was not transparent about its activities.

For the audit, OIG representatives:

- Observed 40 APHIS-WS field personnel from five states with audit locations based on a high take of selected predators, a high number of nontarget kills, or the most hours on the job with the minimal take;
- Interviewed 15 property owners or 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.

OIG auditors observed field personnel setting and checking traps, snares, M-44 devices, and other WDM methods, conducting other typical field activities, and interviewed the employees regarding their use of the APHIS-WS Decision Model (WS Directive 2.201) to assess predation, including auditor confirmation of predator kills of livestock. The auditors watched specifically for indiscriminant killing of nontarget 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 nontarget animals were captured or animals were not killed immediately, the field employee 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 nonlethal 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 nonlethal methods focus on management of the conditions rather than management of the offending animal.

The OIG (2015) 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, OIG (2015) 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.

The US Government Accountability Office (GAO)10, an independent nonpartisan agency that works for Congress often called the "Congressional watchdog," investigates how the federal government spends taxpayer dollars. At the request of Congress, GAO (2001) conducted a review of the APHIS-WS IWDM program in 2001 to determine:

- The nature and severity of threats posed by wildlife, and the need for APHIS-WS programs;
- Actions the program takes to reduce such threats;
- Studies conducted by APHIS-WS to assess specific costs and benefits of program activities; and
- Opportunities for developing effective nonlethal methods of predator control on farms and ranches.

GAO (2001) met with APHIS-WS personnel at the regional offices, program offices in four states, WS-NWRC main office in Colorado, and field research stations in Ohio and Utah. 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*

[10] Information about GAO can be found @ http://www.gao.gov/about/index.html.

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 nonlethal 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 nonlethal 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 nonlethal measures, such as scare devices (e.g., bursts of sound or light)*."

The GAO review found that most nonlethal control methods such as fencing, guard animals, and animal husbandry practices were most appropriately implemented by the livestock producers themselves, with technical assistance from APHIS-WS, and that most cooperators were already using some nonlethal methods before they requested assistance from APHIS-WS.

The two detailed and extensive government audits of the APHIS-WS IWDM program, one requested by Congress and one conducted by the USDA Office of Inspector General, found that the need exists for WDM on public and private lands using both lethal and nonlethal methods as implemented by APHIS-WS when requested for protecting:

- Human health and safety, including threats from predators and zoonoses,
- Livestock, agricultural crops, and other assets and property, and
- Resources under the jurisdiction of federal and state wildlife agencies.

The audits found that:

- Such programs are cost-effective and justified;
- The programs are conducted in compliance with federal and state laws and agency policies and directives; and
- The programs are desired by the affected parties and effective in meeting the needs.

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

Treves et al. (2016) criticized research methods used for evaluating the effectiveness of lethal PDM for protection of livestock and recommended suspension of such PDM methods that do not currently have rigorous evidence for functional effectiveness until studies are conducted using, what the authors called, a "gold standard" study protocol. The "gold standard" protocol recommended by the authors is called the "Before/After-Control/Impact Protocol (BACI)," which uses a sampling framework to attempt to assess status and trends of physical and biological responses to major human-caused perturbations in the environment. It involves sampling in the area proposed for perturbation before the perturbation occurs and after the perturbation occurs, and comparing the results to each other and to those measured in a control area. This type of protocol is often used in controlled biomedical research and point-source pollution or localized restoration studies, where the human-caused perturbation is relatively localized and non-mobile. In order to meet the "gold standard" requested by Treves et al. (2016), BACI is best applied using multiple control sites that are sufficiently similar to the perturbed site (Underwood 1992) in order to overcome inherent natural variability in ecological systems, a very difficult standard. Unreplicated sampling involved in BACI inherently does not provide the strong inferences (Underwood 1992) that Treves et al. (2016) requests for their "gold standard".

In the case of PDM for livestock, finding multiple field study sites that prohibit predator management, but allow livestock grazing is difficult. As experienced in Marin County, California, in the absence of professional predator removal, livestock producers often hire a commercial company to conduct PDM or remove animals themselves, often using methods that are not selective for the offending animal (Shwiff et al. 2005, Larson 2006). Depredation on livestock involves highly mobile animals capable of learning and adapting behaviorally, seasonal, social, and biological variations, highly variable livestock management practices and other 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. WS-NWRC collaborates with experts from around the world to conduct these studies and findings are published in peer-reviewed literature. APHIS-WS supports the use of and uses rigorous, scientifically sound study protocols. APHIS-WS also realizes that field studies involve many variables that cannot be controlled and assumptions that must be acknowledged when trying to analyze complex ecological questions. Wildlife field research is inherently challenging because scientists are often not working in "closed" systems, 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 involving the effectiveness of PDM methods that address livestock depredations, 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, but not from the other. Using study designs with radio collars on highly-mobile terrestrial predators that have interacting social systems also provides a robust method for determining the actual movements, locations, periodicity, seasonality, activity type, social interactions, habitat use, scavenging behavior, and other important factors associated with individual animals, allowing statistical analysis for some study questions and providing the capability for clearer conclusions.

A detailed analysis conducted by APHIS-WS NWRC scientists found that Treves et al. (2016) has misinterpreted and improperly assessed the quality and conclusions of many of the peer-reviewed articles included in their analysis. This causes us to question the authors' abilities to professionally critique such papers and reach such black-and-white conclusions and recommendations. The WS-NWRC evaluation (Appendix G) found that the authors:

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

Incorrectly confused and combined unrelated papers, thus reaching unsupportable conclusions;

Misrepresented the conditions and protocol quality associated with a study testing the effectiveness of fladry;

Misinterpreted study design and criteria used for the selection of paired pastures, and incorrectly discussed the roles of dependent and independent variables;

Made false equivalency regarding the use of government-conducted lethal PDM that focused on removing the individual predators or small groups of predators identified as causing the depredation problem, and regulated public hunting, which is not intended to address predator-caused damage; and

Used conclusions from studies that they identify as "flawed" for reaching their own conclusions.

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

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

1.12 COST-EFFECTIVENESS OF WDM AND NEPA REQUIREMENTS

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 funding to provide PDM services. In general 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 or expected to occur. Typically, WS-Utah assistance is requested when a property owner's level of tolerance has been reached. PDM would reach its maximum success if it prevented all losses or damage from occurring, 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. PDM involves not only the direct costs (costs of actual lethal and nonlethal management), but also costs associated with minimizing risk to people, property, and the environment, and social considerations (Shwiff and Bodenchuk 2004). While some of these are known costs, to conduct a cost:benefit analysis, the value of the damage avoided is needed to make this determination. Inherently, it is difficult to forecast damage that may have been prevented, since the damage never occurred and, therefore, can only be estimated.

Evaluating the economic value of losses that would be avoided or minimized with implementation of a PDM program is difficult and very complex (Shwiff and Bodenchuk 2004). Relevant scientific literature suggests that, in the absence of PDM, 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 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.

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

No. The statute 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 the WDM services, it provides for entering into agreements for collecting funds from cooperators for the services the agency provides.

1.12.2 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 cannot be quantified 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.

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.*" (Emphasis added)

WS-Utah 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 (WS Directive 2.201) 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, which were eliminated (e.g. 1080 bait stations); however, the livestock protection collar (LPC), which is highly specific to the offending animal (Shelton 2004), still delivers minor amounts of the chemical, but at a much higher cost in terms of time and labor. Also, state and local jurisdictions are limiting the methods available for PDM such as foothold traps. 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 that are of value to humans can be considered in qualitative or economic terms. The Memorandum entitled "Incorporating Ecosystem Services into Federal Decision Making" issued by CEQ, the Office of Management and Budget, and the Office of Science and Technology Policy on October 7, 2015[11] 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 4 and the agency's decision based on all considerations, including non-quantifiable values, will be explained in the decision document.

1.12.3 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 IPDM programs. APHIS-WS disagrees with the author's conclusion and recommendations. Loomis (2012) argued 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) questioned the actual need for livestock protection from predators in support of agricultural profitability, and strongly recommended 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.

Loomis (2012) used examples of agencies that either fund or construct major civil works (capital improvement projects) with long life spans, such as the US Army Corps of Engineers (USACE),

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11 @ https://obamawhitehouse.archives.gov/sites/default/files/omb/memoranda/2016/m-16-01.pdf. *Last accessed 10/2/2017*.

the Federal Highway Administration, the Bureau of Reclamation, Tennessee Valley Authority, and the Federal Emergency Management Agency (FEMA). Loomis (2012) especially used the National Economic Development requirements for large water projects funded or constructed by Bureau of Reclamation and USACE as the example for APHIS-WS use. However, Congress has specifically required that the Bureau of Reclamation and USACE consider the National Economic Development for decision-making for their large civil works water projects such as large dams and river management, etc.) that ". . . *necessarily confronts choices among possible alternative courses of actions that involve tradeoffs in economic and other opportunities*" (USACE 2009). The National Economic Development is required and USACE (2009) states "*Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units…*" And [with regards to selecting 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 Bureau of Reclamation 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 National Resources Conservation Service, 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 (The National Resources Conservation Service Manual 200 Natural Resources Economic Handbook Part 613.0; http://directives.sc.egov.usda.gov/viewDirective.aspx?hid=37536). The Federal Highway Administration 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 the example agencies for their economic analyses in NEPA used by Loomis (2012) are not directly relevant to a "fee for service" agency such as APHIS-WS that 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 remaining agency decisions 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 National Economic Development 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 and capital improvement projects are not applicable for APHIS-WS decision-making at the national, regional, or local levels.

1.12.4 How Have Recent Studies Considered Economic Evaluation of WDM Activities

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

A study in Wyoming of ranch-level economic impacts in a range cattle grazing system conducted by economics professors at the University of Wyoming (Rashford et al. 2010), indicated 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 United States viable and profitable through the open spaces and wildlife habitat they provide. The study concluded 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 GAO (2001) concluded, based on studies focused on specific APHIS-WS PDM activities in different areas of the country that were evaluated, that PDM for the protection of livestock are economical, with cost:benefit ratios ranging from 1:3 (comparing the market value of all livestock saved in 1998 with the cost of all livestock protection programs in place) to 1:27 (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 cost:benefit ratio of 1:2 to 1:27. Activities performed to protect human health and safety are impossible to quantify because the value of a human life is incalculable. GAO (2001), however, recognized that estimates of the economic benefits (savings) associated with program activities are based largely on predictions of the damage that would have occurred had the program's control methods been absent, with inherent uncertainties, substantial variations in circumstances, and inability to distinguish between the results of PDM activities and other factors such as weather, disease, and natural fluctuations in predator and prey populations.

Most economic analyses of the relationship of livestock profitability and predator control are conducted at the scope of contribution to local and regional economies. This approach dilutes the recognition that some ranch operations are impacted financially by predation at a higher rate than others, depending on factors such as livestock being grazed adjacent to quality predator habitat such as ranches near federal lands resulting in "*predator drift*", grazing overlapping with predator territories, and grazing in areas with high concentrations of unprotected livestock, especially during lambing and calving (Shelton 2004). 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 (e.g., Rashford et al. 2010, Loomis 2012). This approach also does not consider support for other needs for which APHIS-WS is routinely requested, such as threats to human and pet health and safety, operations at airports, risk of wildlife disease spread, and protection of property.

A team of economic specialists from WS-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 field specialists. Results of the study indicated that for every $1.00 California counties invested in APHIS-WS, they saved 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 cost to benefits. An economic assessment of the California Cooperative Animal Damage Control program was completed for a 10-year period between 1980 and 1990. The results showed a cost:benefit ratio of 1:8 for direct producer benefits, and a cost:benefit ratio of 1:21 for the general public (USDA 1991). Schwiff and Merrill (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.

1.12.5 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 because many losses are not reported to authorities, not all losses are found in the field, or many carcasses found are too consumed or decayed to make a clear determination for 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 PDM and may be evaluated using multiplier values from the direct benefits. Spillover benefits include indirect benefits to local and regional economies and incidental benefits to wildlife populations in the same geographic area.

- **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 nonlethal PDM activities for protection of livestock 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 losses alter producer purchases of supplies from other industries in the region and outside the region, which otherwise result 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. Since different economic studies use different factors, values, and multipliers, it can make comparisons difficult to make.
The following summarizes the types of economic analyses typically applied to PDM, especially associated with livestock contributions to regional economies (discussed in Schuhmann and Schwabe 2000, Shwiff et al. 2005, Rashford and Grant 2010, Loomis 2012, Shwiff et al. 2012):

- **Cost:Benefit Analysis:** Considers measures of costs that include financial costs (out of pocket expenditures for PDM methods such as fencing and guard dogs) and opportunity costs (benefits that would not be availability to society based on predator control actions taken today), and measures of benefits as evaluated by a consumer's (increase in enjoyment/satisfaction) or producer's (increases in profit) willingness-to-pay (WTP) for one more unit of the identified "good", considered either on a personal level or societal level. On a personal level, the "good" is considered to have economic value if the individual person (recognizing that individuals have differing value systems) receives enjoyment/satisfaction from the "good" and if the "good" is to some degree scarce. Opportunity costs must also be considered – costs or 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 attempts at quantification, as the direct and indirect factors and discount rates included in such an analysis must be carefully considered and accurately evaluated for the contribution they play; otherwise, this type of analysis can substantially misrepresent the actual situation and be readily disputed. Section 1.10.5.3 gives examples of this approach for large capital improvement projects considered at the project-level basis, but applied to 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 (WTP):** Studies have identified the WTP for non-market goods such as wildlife recreation (mostly hunting, fishing, and wildlife viewing) for individual species, and, to a substantially lesser degree, ecosystem services, such as clean drinking water, pollination and pest control for agriculture, and renewal of soil fertility. WTP can also be used to monetize existence or passive values, such as the value of knowing that a species exists somewhere in the wild, even if the individual never spends any money to actually experience it in the wild. Methods used to determine or using WTP have included:

  - **Recreational Benefits:** Considering the costs of travel to experience enjoyment of non-market recreational experiences (Travel-Cost Method; TCM), using a demand curve above actual travel costs obtained through surveys with recreationists, reflecting actual behavior. Shwiff et al. (2012) summarize the primary criticisms of TCM: assumptions that visitors' values equal or exceed their travel costs because travel costs are not an accurate proxy for of the actual value of the good; values must also be assigned to the time individuals spend traveling to the site, including opportunity costs (time spent traveling cannot be spent doing some other activity) since each person values their time differently; human access to conservation sites may be limited including access to private land, and individuals may not be aware or have a preference toward the species associated with a chosen recreation site; and if individuals are not willing or able to travel to the site to expend funds, then this method confers no value.

  - **Existence/ Altruistic/Bequest Benefits:** These are benefits enjoyed by the individual now, 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, or 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) summarized the primary criticisms of CVM and included 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) summarized 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) described 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.

Schuhmann and Schwabe (2000) concluded that:

- "*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 (2006) 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 by a federal agency must have the survey questions and designs approved by the Office of Management and Budget. Developing a high-quality survey requires professional assistance in designing, executing, and documenting the survey. This requirement makes it very difficult and expensive to conduct public surveys.

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

1.12.6.1 What is the Marin County Predator Replacement Program?

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

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

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

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

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

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

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

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

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

The study found that the costs of replacing WS-California activities with private activities for WDM in the cooperating counties was almost $174,000 in year 1 and over $226,000 in year 2, while county share to WS-California for providing those services averaged almost $52,000, showing substantial savings using the federal program. Assuming that damage from wildlife would increase from 25% to 100% without WS-California activities, the counties would have incurred between $5,759,000 and $10,636,000 in additional expenses. The net value of WS-California operations was calculated to range from approximately $10,394,000 and $17, 257,000.

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

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

CHAPTER 2: ISSUES AND AFFECTED ENVIRONMENT

2.1 INTRODUCTION

Chapter 2 contains a discussion of the issues that will receive detailed environmental impacts analysis in Chapter 4 (Environmental Consequences), issues that were used to develop minimization measures and SOPs, and issues that will not be considered in detail, with brief discussion of those issues. Also included are a list of issues identified and addressed in the 1996 EA's and Decision's on Predator Damage Management in Southern and northern Utah, but for which explanations will not be repeated in this document. Pertinent portions of the affected environment will be included in this chapter in the discussion of the issues. Additional affected environments will be incorporated into the discussion of the environmental impacts in Chapter 4 and the description of the current program (the "no action" alternative) in Chapter 3.

2.2 ISSUES ANALYZED IN DETAIL IN CHAPTER 4

The MAT, consisting of representatives from the lead (WS-Utah) and cooperating agencies (BLM, Forest Service, UDWR, UDAF), identified the following issues, which were also raised during the public involvement process:

Issue 1. Effects of WS-Utah PDM on Target Species Populations

Issue 2. Effects WS-Utah PDM on Nontarget Species (including T&E and Sensitive species)

Issue 3. Humaneness and Ethics of WS-Utah PDM

Issue 4. Effects of PDM on Public and Pet Safety

A detailed description of the issues is contained in the following discussion:

2.3 ISSUES ADDRESSED IN THE ANALYSIS OF ALTERNATIVES

2.3.1 Effects of WS-PDM on Target Species Populations

Maintaining viable populations of all species is a concern of the public and of biologists within the state and federal land and wildlife management agencies, including WS-Utah. This Section addresses concerns that WS-Utah PDM would adversely affect populations of target species for each of the alternatives. The primary target species analyzed in is EA (Table 1) include coyotes, black bears, mountain lions, bobcats, badgers, raccoons, striped skunks, and red foxes. Species rarely encountered in PDM, if at all, are long- and short-tailed weasels, river otters, mink, ringtails, gray and kit foxes, and western spotted skunks (Table 1). Domestic animals that are analyzed, but from a different perspective since they are not "wildlife" include domestic and free roaming dogs, cats, and ferrets (Table 1).

Impacts to Populations of Target Species

The analyses of these issues are inherently a cumulative impact analysis, because many direct and indirect factors impact a species' populations, including climate change, quality of and changes to habitat (such as human development or fires), consumptive uses, and a variety of sources of mortality.

2.3.2 Effects of WS-Utah PDM on Nontarget Species (including T&E and Sensitive Species)

A common concern among members of the public and wildlife professionals, including WS-Utah, is adverse effects of PDM methods to nontarget wildlife populations. The use of nonlethal and lethal methods has the potential to inadvertently disperse, capture or kill non- target wildlife. To reduce the risks of adverse effects to nontarget wildlife, WS-Utah would select damage management methods that are as target-selective as possible or apply such methods in ways to reduce the likelihood of capturing or otherwise adversely impacting nontarget species. Standard Operating Procedures implemented by WS-Utah help to reduce the effects of PDM on nontarget species populations and are presented in Chapter 3

To reduce the risks of adverse effects on nontarget species, WS-Utah coordinates its activities on public lands with the land management agency to reduce negative impacts from other activities[12] and selects methods that are as target-selective as possible or apply such methods in ways to reduce the likelihood of adversely affecting nontarget species populations. WS-Utah follows program Directives, applicable federal, state, and local laws, and consults with land and wildlife management agencies. For operational PDM activities, WS-Utah selects the most effective method to reduce the damage caused by the target species. WS-Utah uses trained professional employees to conduct operational damage management programs. On April 5, 2017 the WS-Utah Biological assessment was signed by the USFWS to comply with the ESA and preclude adverse impacts to listed species. SOPs to prevent adverse impacts to nontarget wildlife, including federally listed species and state sensitive species are included in Section 4.4.1.2.

Impacts to Populations of Nontarget Species

The analyses of these issues are inherently a cumulative impact analyses, because many direct and indirect factors impact a species' population, including climate change, quality of and changes to habitat (such as human development or fires), consumptive and non-consumptive uses, and a variety of sources of mortality.

Relationship of Removal of Apex Predators/Trophic Cascades/Maintaining Biodiversity/Mesopredator and Prey Release/Ecosystem Services

The analysis of this issue is inherently a cumulative impact analysis, because many direct and indirect effects impact the complex interrelationships among and between trophic levels, habitat, biodiversity, and the species themselves. This analysis is based on scientific literature and the impact analyses for target and nontarget species in Utah.

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12 These other activities could include road construction, oil and gas development, timber harvest, or other activities that occur on public lands.

Agencies, tribes and the public are also concerned about the potential for indirect impacts on nontarget species and ecosystems that could occur as a result of changes in predator populations caused by use of some PDM actions. Concerns related to this issue include the potential for WS-Utah actions to impact trophic cascades, biodiversity, and ecosystem resilience. An example of the type of concern addressed in this Section is a review of the potential for WS-Utah actions to reduce one predator species (e.g., coyotes) to result in increases in other smaller predator species populations (e.g., red fox) and cause indirect adverse impacts on prey populations such as ground nesting birds.

2.3.3 Humaneness and Ethics of WS-Utah PDM

Public attitude towards PDM (Ethics)

Many people are also concerned with the humane treatment of animals. The issue of humaneness and other sociological issues including ethical perceptions pertaining to PDM can be interpreted in a variety of ways depending upon individual perspectives, philosophies and experience. This section reviews the varying perspectives on this issue relative to the proposed management actions for each alternative.

WS-Utah personnel are concerned about the ethics of all WDM activities. APHIS is aware that some WS-Utah activities are philosophically contentious, but also believes that these activities are conducted as ethically, humanely and responsibly as possible. Research continues on the development of improved and humane damage management methods. The WS-Utah program is not directed at large-scale destruction of wildlife, but rather at responding to requests for operational damage management and technical assistance in cases where people or communities are experiencing wildlife damage or threats. In responding to such requests, WS-Utah personnel use and recommend nonlethal damage management methods when practical (Appendix E). In doing so, the WS-Utah program does not characterize particular wildlife species as good or bad, but recognizes that any wildlife species can cause damage and that such damage should be responded to in a professional manner.

Debate continues within the natural resources profession about the appropriate ethical stance on the degree or methods by which ecosystems can or should be managed (Callicott 1990, Soule 1990, Ehrenfeld 1991). WS as well as many organizations and individuals share the ecological ethic of wildlife managers as identified by Leopold (1949), which stresses the importance of considering effects to the ecosystem rather than the individual. Some of the groups that participated in the public involvement process for this EA supported governmental involvement in PDM. Other groups were more aligned with beliefs that nature has rights and that man should not have dominion over nature. These groups may be aligned with animal rights groups (Jamison and Lunch 1992). Animal rightists believe that animals have inherent "rights" comparable to humans (Singer 1975) and oppose killing or harming animals for human gain. At the extreme, they support: 1) the total elimination of commercial and sport hunting and trapping, 2) the total dissolution of commercial animal agriculture, and 3) the total abolition of the use of animals in science (Bleiberg 1989). Hutchins and Wemmer (1986, 1987) provide an excellent discussion of issues in wildlife conservation that involve animal rights concerns.

WS-Utah and the cooperating agencies agree that PDM methods must be appropriate, humane and ethical. WS-Utah plans to implement an alternative that will effectively reduce predation while also being ethical and humane, appropriate to each unique circumstance, and targeted at those animals that are found to be causing damage.

In addition, it has been argued that man has a moral obligation to protect domestic animals from predators. Predators frequently do not kill larger prey animals quickly, and will often begin feeding on them while they are alive and still conscious (Wade and Bowns 1982). Thus, for PDM to be successful, livestock producers and resource managers need to incorporate a variety of techniques that integrate social, ethical and economical concerns, as well as the biology of the species in the development of management strategies.

2.3.4 Effects of PDM on Public and Pet Safety

Conflicts between wildlife and human interests and the resultant WDM needs are highly variable due, in part, to the wildlife species involved, the scope of the damage, the resource being damaged, and the behavior of the wildlife species and people involved. Damages may be minor, or may be of such severity as to take human life, reduce wildlife populations, or significantly affect economic livelihoods of citizens or communities. In addition to the issue of losses, there is the basic philosophical and ethical reason for the Federal government to be involved in wildlife and WDM (see Section 1.4).

These issues mostly involve direct effects (the risk of potentially "one-off" impacts) and not cumulative impacts. Except for issue 5 (as many communities are adversely impacted by a variety of factors).

1. Potential exposure of WS-Utah employees to disease from handling animals
2. Potential for the public, employees, and surface water to be exposed to chemical such as pesticides, hazardous materials, immobilizing/euthanasia chemicals, pyrotechnics, and mechanical tools, such as traps, snares, shooting, during field operations
    - 2.a. Public exposure
    - 2.b. Employee exposure
    - 2.c. Water quality
3. Employee crew safety during aerial PDM operations
4. Risk of employees being attacked or bitten by captured animals
5. Potential for impacts to Environmental Justice communities (E.O. 12898; Appendix B), adverse impacts to human communities even if not a disproportionate impact, and potential impacts to children (E.O. 13045; Appendix F)

Lead contamination from Use of Leaded Ammunition

These analyses are inherently cumulative impact analyses, because there are many sources of lead in the environment, and lead may travel through different media to potentially impact a variety of receptors.

1. Environmental fate and exposure through soil
2. Environmental fate and exposure through water media
3. Aquatic vertebrates, invertebrates, and plants
4. Terrestrial plants
5. Reptiles and terrestrial invertebrates
6. Migratory birds, including predatory birds
7. Mammals
8. Human health (includes consumption of game meat)

2.4 AFFECTED ENVIRONMENT

Utah encompasses approximately 84,899 square miles (≈ 54.3 million acres) and is comprised of 29 counties. WS-Utah personnel receive requests to conduct PDM throughout the various counties on private, federal, State, tribal, county and municipal lands. Of the total acreage in Utah, about 38.6 million acres (71.5%) are federally managed lands. The USFS manages about 8,179,174 acres; 22,788,139 acres are managed by the BLM; and about 2,208,513 acres are managed by other federal agencies (DOE, DOD, BR, NPS). Tribal lands consist of about 2,448,831 acres of land in Utah. In addition to the federally managed lands, there are about 5,446,918 total acres owned and managed by State agencies (i.e., SITLA and UDWR etc.). (As per Carmen Bailey, Public Lands Policy Coordination Office)

As of June 14, 2015, WS-Utah has cooperative agreements in place to work on approximately 30 million acres, or about 55.2%of the State's total acreage (MIS 2015) . WS-Utah typically only works on about 45% (MIS 2015) of all lands under agreements every year (about 24.1% of all lands in Utah, or about 13.1 million acres) and of those lands, actual PDM activities occur on only about 50% (<12.7% of all lands in Utah, or about 6.9 million acres) of those total land masses. The program does not work continuously throughout the year on most of the properties and only works on a very small percentage of the total numbers of acres for each property under agreement. Additionally, WS-Utah typically spends only a few hours or days on any specific property during the year resolving damage problems.

During FY 2015 WS-Utah conducted PDM on properties totaling approximately 13.1 million acres (about 24.1% of all lands in Utah and about 55% of all lands that WS-Utah have under signed agreements) where target predators potentially were taken (MIS 2015). Of the 13.1 million acres, about 8.3 million acres were on BLM lands; 2 million acres of USFS lands; 10,910 acres of "other" federally-owned/managed lands; 908,222 acres of State lands; and 2.5 million acres on private property. A summary of federal public lands in Utah, the probability that PDM may be conducted on those lands under the current program, and the types of tools which may be used is provided in Appendix E.

Components of the environment to be examined in this EA are wildlife populations, including sensitive and T&E species, livestock production and predation, protection of public health and safety, and social attitudes. The WS program, due to its limited scope, has limited effects on other components of the environment. Evaluations of the program have shown there are no effects on soils, silvacultural practices, water, cultural resources, air quality, prime or unique farmlands, floodplains, wetlands or riparian zones (BLM 1994a, 1994b and 1994c, Forest Service 1991).

2.4.1 The *"Environmental Status Quo"* for Reducing Damage and Conflicts Associated with State Managed or Unprotected Wildlife Species.

As defined by NEPA implementing regulations, the "*human environment* shall include the natural and physical environment *and the relationship of people with that environment*" (40 CFR 1508.14). Therefore, when a Federal action agency analyzes its potential impacts on the "human environment," it is reasonable for that agency to compare not only the effects of the Federal action, but also the potential impacts in the absence of the Federal action or actions potentially taken by others. This concept is applicable to situations involving Federal assistance to reduce damage associated with state-resident wildlife or unprotected wildlife species.

Utah resident wildlife is managed under state authority or law without any federal oversight. For PDM in Utah, any government or private entity has the authority to take predators for damage management purposes (UCA Title 4 Chapter 23 and specific UDWR Regulations). When a non-federal entity (*i.e.,* state wildlife, agriculture or health agencies, municipalities, counties, private companies, individuals, etc.) takes a management action on a state-resident wildlife species or unprotected wildlife species, the action is not subject to NEPA due to lack of federal involvement. Under such circumstances, the environmental *baseline* or *status quo* must be viewed as an environment that includes predators *as they are managed or impacted by non-federal entities*. Therefore, for those situations in which a non-federal entity has decided that a management action will occur and even the particular methods that will be used, WS-Utah involvement will not affect the *environmental status quo (ESQ)*.

Therefore, in those situations where a non-federal cooperator has obtained the appropriate permit or authority, and has already made the decision to remove predators to reduce damage with or without WS-Utah assistance, WS-Utah participation in carrying out the action will not affect the ESQ. In some situations, however, certain aspects of the human environment may actually benefit more from WS-Utah involvement. For example, if a cooperator believes WS-Utah has greater expertise to selectively remove a target species than a non-WS-Utah entity; WS-Utah involvement would actually have a *beneficial* effect on the human environment.

2.4.2 Special Management Areas

Some members of the public may be concerned that WS-Utah PDM activities could conflict with recreational activities such as hunting and fishing and non-consumptive uses, such as wildlife viewing or hiking.

SMAs are areas identified by the AWP as areas needing additional guidance from the land managing agency, such as Wilderness Areas (WA). Recreationists and others interested in special management areas may consider WS-Utah damage management activities to be an invasion of solitude and that it may adversely affect the aesthetic quality of wilderness experiences. WS-Utah PDM is conducted (and is proposed to continue) when and where a specific need is identified, only when allowed under provisions of the specific wilderness designation, and under the authority of the appropriate land managing agency. WS-Utah activities in special management areas have historically been, and are expected to continue to be a minor part of the overall WS-Utah PDM program.

Some believe that methods used on public lands should be different than those used on private lands. Much of WS-Utah consists of federal lands and many different types of areas exist on these federal lands that have a special designation and/or require special management consideration. These include WA or primitive areas (PA), wilderness study areas[13] (WSA), national parks and recreation areas, national wildlife refuges, national monuments and Areas of Critical Environmental Concern (ACEC) (Appendix B). In addition, tribal, private, municipal, county, other state agency, and National Park and Recreation Area lands exist within the state. In Utah there are about 8,170,935.82 acres administered by Forest Service, 22,800,418.52 acres administered by the BLM, and 3,407,991.96 acres administered by the Utah School and Institutional Trust Lands Administration.

Management goals for these different areas varies considerably by designation and land management agency mission, and are governed by different legal mandates.

WSA are areas studied for their potential to qualify as WA and are currently awaiting Congressional designation. These are primarily BLM lands and are managed according to BLM's WSA Handbook H-8550-1 in a way that does not diminish their wilderness values. This management does allow for continuation of most prior (non-land disturbing) activities and does not preclude PDM (see Appendix B for a complete listing of WSAs, WAs, ISAs, PAs). PDM has only occurred on a small portion of the WSAs, WAs, ISAs, or PAs, and has complied with BLM's policy.

Both WS-Utah and the Forest Service were sued relative to predation management efforts in designated WA (Forest Guardians, et al. v. APHIS et al., District Court for the District of AZ, 2000) in a case that ultimately was affirmed by the 9th Circuit Court of Appeals. The Courts

13 Existing WSA could be officially designated as WA in the future.

held, in part, that PDM is not inconsistent with the purposes of the Wilderness Act and may be allowed within the administrative processes used by WS-Utah and the Forest Service.

While Research Natural Areas (RNA) and ACECs are Federal lands for which special management is deemed necessary; it should be noted that the legal mandate for designation and management for RNAs/ACECs comes from the Federal Land Management and Policy Act and is considerably different from wilderness designations. The Act defines an RNA/ACEC as an area "*within the public lands where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards.*" RNAs/ACECs can be and are designated for a variety of special management situations ranging from maintaining near pristine scenic quality to the management of a hazardous waste dump. RNAs/ACECs can be and are often designated for multiple uses and RNA/ACEC designation does not, by itself, preclude PDM. Rather, the individual management prescriptions developed and presented within a given RNA/ACEC management plan determines what is allowable. Historically, PDM has not been conducted within these areas.

The Grand Staircase-Escalante National Monument (GSENM) was created by President Clinton under the Antiquities Act on September 18, 1996. Pursuant to the creation order, the BLM retains land management authority and has created a management plan. Also pursuant to the order, nothing in the creation of the GSENM will diminish the States responsibility for the management of wildlife. The AWDPB adopted a policy on December 5, 2003, and was re-affirmed by the board on December 4, 2015 which directs State management of predators within the GSENM.

2.5 ISSUES NOT CONSIDERED IN DETAIL AND WHY?

In addition to the four primary issues identified for in depth analysis, severeal other issues listed below are discussed but will not be included for further analysis in chapter 4 of this EA with reasoning provided.

The bulleted list issues are not considered in detail because they are outside the scope of this EA:

- **APHIS-WS activities could conflict with ongoing wildlife field research**: Commenters have raised concerns that APHIS-WS PDM activities could interfere with ongoing wildlife research being conducted by state or educational entities. An example could include WS-Utah removing a mountain lion predating on livestock wearing a radio collar placed by UDWR. WS-Utah coordination with UDWR, a tribe, or a federal or state land management agency would typically identify such ongoing research so that the two agencies would communicate about potential conflicts. Such research occurring on USFS or BLM lands would also be identified during development of the Annual Work Plan.

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

  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-Utah operations, based on previous PDM EAs prepared in the Western United States and in Utah. They will not be discussed further in this EA.

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

- **Visual quality:** WS-Utah operations do not change the visual quality of a public site or area. Although physical structures may be recommended as part of technical assistance, they are not constructed by WS-Utah and therefore not under the agency's jurisdiction.

- **General soils:** (except for 2.3.4 Lead Contamination Issue 1: the environmental fate of lead in soils): WS-Utah 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-Utah 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 wilderness and wilderness study areas; see Chapter 1.14.3 and 2.3.3)**:** WS-Utah operations do not involve permanently converting the land use of any kind of farmlands.

- **Air quality:** WS-Utah's emissions are from routine use of trucks, airplanes, and very limited use of harassment devices using explosives, and therefore constitute a *de minimis* contribution to criteria pollutants regulated under the Clean Air Act (See Chapter 4.1.4 for discussion of climate change).

- **Vegetation**: including timber and range plant communities: WS-Utah operations do not change any vegetation communities or even small areas of plants.

- ***Environmental effects of the loss of individual animals:*** **C**omments 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-Utah PDM activities. All WS-Utah PDM activities are conducted under the authorization of and in compliance with Federal and state laws and in coordination with the UDWR, USP, BLM, or the USFWS, as appropriate. Although we recognize that some individuals could find this loss distressing, analysis in Chapter 4.5 and 4.6.2 indicates the current and proposed actions involving only removal of individual offending animals or, especially under preventive treatment in an area, multiple predators of a species within a localized area, would not in any way have environmental impacts on any of the wildlife populations involved in WS-Utah's operations, including ESA-listed species (Ch 4.4.1.2).

2.5.1 Potential for Lethal PDM to Cause Increased Coyote Populations and Increased Predation through Compensatory Reproduction:

Assessing the effect of damage management programs on coyote populations requires an understanding of the mechanisms and behaviors involved in regulating coyote demographic processes (Knowlton et al. 1999). Coyotes are territorial with territories spaced contiguously across the landscape like pieces of a puzzle, and coyotes are territorial year-round residents, living in summer where they can survive in winter (Weaver 1979, Gantz 1990, Shivik et al. 1996). Hence, territory density remains relatively constant (Knowlton et al. 1999) with each territory maintained and controlled by a dominant pair of coyotes (alpha pair), with associated coyotes, including pups (beta coyotes) (Gese et al. 1996a, 1996b). Populations also include transient and dispersing individuals. In addition, coyotes are monestrous with only the dominant breeding pair typically producing a single litter per territory each spring (Kennelly and Johns 1976); beta females may also produce offspring, but this rarely occurs (Gese et al. 1996a). Because stable populations require that on average breeding adults only recruit enough surviving offspring into the breeding population to replace themselves, normally less than 10% of the young from a given pair of coyotes need to survive and reproduce to maintain the population (Knowlton et al. 1999). The other 90% die, disperse, or fail to reproduce.

Available food, especially in winter (Weaver 1979, Gese et al. 1996a), is often considered the major factor regulating coyote abundance (Gier 1968, Clark 1972), mediated through social dominance and territoriality (Knowlton and Stoddart 1983, Gese et al. 1988, 1989, Knowlton and Gese 1995, Windberg 1995). Some researchers believe food abundance regulates coyote numbers by influencing reproduction, survival, dispersal, space-use patterns, and territorial density (Gier 1968, Knowlton 1972, Todd et al. 1981, Todd and Keith 1983, Mills and Knowlton 1991, Gese et al. 1996a). In contrast, Crabtree and Sheldon (1999) suggested that litter size at birth (among coyotes) appears relatively invariant with respect to changes in prey abundance, and that litter size at birth appears largely unaffected by levels of human exploitation. Connolly and Longhurst (1975) demonstrated that coyote populations in exploited and unexploited populations do not increase at significantly different rates and that an area will only support a population to its carrying capacity.

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 reductions have occurred. Several studies (Connolly et al. 1976, Gese and Grothe 1995, Conner 1995, Shivik 1995, Sacks 1996, Shivik et al. 1996, Gese 1999) investigated the predatory behavior of coyotes and determined that the more dominant (alpha) animals (adult breeding pairs) were the ones that initiated and killed most of the prey items, and ostensibly to provision pups (Till 1992, Till and Knowlton 1983). Concerns that coyote removal activities might exacerbate predation on livestock appear to be unfounded since the removal of local territorial (dominant, breeding adult) coyotes actually removes the individuals that are most likely to kill livestock and generally results in the immigration of subdominant coyotes that are less likely to prey on livestock.

The issue whether removing coyotes exacerbates livestock losses by: 1) encouraging immigration of other coyotes, and/or 2) increasing coyote numbers through compensatory reproduction is analyzed below. WS-Utah is unaware of any scientific data that would prove speculation about unexploited coyote populations posing less risk to livestock than exploited populations. Windberg et al. (1997a) noted that 65% of the coyotes exposed to a herd of goats fed upon them even though the goats were present for only 21 days. Windberg (1997b) reported that a high incidence of coyote predation on goats during their study with an unexploited coyote population was contrary to Dr. Crabtree's hypothesis. They found no statistically significant difference between territorial and transient coyotes in the proportion of each type that consumed Angora goats 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 on 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 by winter aerial hunting 5-6 months ahead of summer sheep grazing, whereas total lamb losses only declined 6% on allotments that were not aerial hunted. Confirmed losses to coyotes declined by 7% on aerial hunted allotments, but increased 35% on allotments receiving no aerial hunting (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 result in increased losses. In addition, Wagner (1988) presented evidence of a positive association between coyote densities and predation losses of sheep.

On the contrary, research on lamb and sheep losses with restricted or no PDM show that coyote damage management is effective in reducing losses. This was supported by a review by the Government Accounting Office which concluded that, *"according to available research, localized lethal controls have served their purpose in reducing predator damage"* (GAO 2001). Further, an analysis in Knowlton et al. (1999) supports the GAO conclusions. This issue was also addressed in *Southern Utah Wilderness Alliance* v. *Thompson* (U.S. District Court of Utah 1993) and addressed by Connolly (1992). What happens in an unexploited coyote population bears little relevance to the situation in Utah or in most other areas of the U.S. As noted in the EA, coyote populations in Utah are subject to mortality not only from WS-Utah, but also from natural mortality, Utah DWR predator control program initiated with the "Mule Deer Protection

Act" in 2012, private trappers and hunters as well as ranchers protecting their stock. Without a federal WS-Utah program, private fur harvest and PDM efforts would still likely be carried out by other entities.

Further, mortality in coyote populations can range from 19-100% with 40-60% mortality most common. Several studies of coyote survival rates, which include calculations based on the age distribution of coyote populations, show typical annual survival rates of 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 (USFWS 1978). Mortality rates among *"unexploited"* coyote populations were reported to be between 38-56%. Thus, most coyote populations, even those that are not subjected to damage management, have high mortality rates which are not stable. Furthermore, in studies where reported coyote mortality was investigated, only 14 of 326 recorded mortalities were due to WS-Utah activities (USFWS 1978). Dispersal of *"surplus"* 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 reductions have occurred.

2.5.2 Wildlife Damage Management Should Be Conducted by Private Nuisance Wildlife Control Agents:

Private nuisance wildlife control agents could be contacted to reduce wildlife damage for property owners or property owners could attempt to reduce their own damage problems. Some property owners would prefer to use a private nuisance wildlife control agent because the nuisance wildlife agent is located in closer proximity and thus could provide the service at less expense, they are not required to comply with NEPA, or because they prefer to use a private business rather than a government agency. However, some property owners would prefer to receive assistance from a government agency. In particular, county governmental agencies, large industrial businesses, airport managers, and municipalities may prefer to use APHIS-WS because of security and safety issues, legal requirements to be accountable to the public through NEPA compliance and reduced administrative burden.

2.5.3 Global Climate Change/Greenhouse Gas Emissions:

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

APHIS recognizes that climate change is an ongoing concern and may result in changes in species range and abundance. Climate change is also anticipated to impact agricultural practices. The combination of these two factors over time is likely to lead to changes in the scope and nature of wildlife-human conflicts in the state. Because these types of changes are an ongoing process, the EA has developed a dynamic system including mitigations and standard operating procedures that allow the agencies to monitor for and adjust to impacts of ongoing changes in the affected environment (Section 3.4 and 3.5). APHIS-WS 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 EA. WS-Utah would supplement the analysis and/or modify program actions in accordance with applicable local, State and federal regulations including the NEPA if substantive changes in the potential environmental effects of program actions warranting revised analysis are identified. Established policies also include reporting all take to the USFWS and MFWP annually as appropriate for review of project-specific and cumulative impacts on wildlife populations. Coordination with agencies that have management authority for the long-term wellbeing of native wildlife populations and review of available data on wildlife population size and population trends enables the program to check for adverse cumulative impacts on wildlife populations, including actions by WS-Utah that could jeopardize the long-term viability of WS-Utah actions on wildlife populations. Monitoring would include review of federally-listed T&E species and consultation with the USFWS, as appropriate, to avoid adverse impacts on T&E species. As with any changes in need for action, WS-Utah would supplement the analysis and/or modify program actions in accordance with applicable local, State and federal regulations including the NEPA, as needed, to address substantive changes in wildlife populations and associated impacts of the PDM program. In this way, we believe the proposed action accounts for is responsive to ongoing changes in the cumulative impacts of actions conducted in Utah in accordance with the NEPA.

The CEQ has advised federal agencies to consider whether analysis of the direct and indirect greenhouse gas (GHG) emissions from their proposed actions may provide meaningful information to decision makers and the public (CEQ 2014). Based on their review of the available science, CEQ advised agencies that if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis the agencies should consider that a quantitative and qualitative assessment may be meaningful to decision makers and the public (CEQ 2014). APHIS has assessed the potential GHG impacts from the national APHIS-WS program and current and proposed actions in context of this guidance.

The average person in a home produces four metric tons of carbon dioxide equivalents (CDEs includes CO_2, Nox, CO and Sox) annually (EPA 2010). Nationwide, APHIS-WS has 170 district and State Offices and this includes district offices with only one staff person. Each State Office would likely produce fewer CDEs annually than the average home because little electricity is used at night and on weekends.

APHIS-WS vehicles are used for a multitude of wildlife management projects, including current Utah 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. However, APHIS-WS used the Federal Highway Administration estimated average combined fuel economy of cars and light trucks of 21.5 miles per gallon (mpg) in the discussion of alternatives. To establish baseline data on the National WS program, WS calculated the CDEs from its current fleet of passenger vehicles (1,665 leased and owned vehicles) using the average vehicle miles traveled per year as calculated by Federal Highway Administration (2010)[14]. APHIS used the ratio of CO_2 equivalents (CDEs) to total greenhouse gas emissions for passenger vehicles to complete the calculation.[15] Current APHIS vehicle use for all wildlife management programs can contribute approximately 8,058 metric tons (MT) of CDEs each year.[16]

Nationwide, APHIS-WS either owns or leases ten different types of helicopters; their average fuel consumption is 24.88 gallons per hour (gph). Helicopters with this average fuel consumption emit approximately 0.24 MT/hr of CO_2 emissions.[17] APHIS-WS also owns or leases six different types of aircraft. 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 flight hours were attributed to fixed-wing planes, the estimated CO_2 emissions would be 1,612 MT/year. If all flight hours were attributed to helicopters, the estimated CO_2 emissions would be 3,516 MT/year. Combining vehicle, aircraft, office and ATV use for FY 2013 and potential new vehicle purchases, the range of CDEs is likely to be 10,350 – 12,254 MT or less per year, which is below the CEQ's suggested reference point of 25,000 MT/year.[18]

APHIS-WS understands that climate change is an important. The WS-Utah program would 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 proposed

14 11,493 miles per vehicle per year

15 0.985

16 (8.92 × 10-3 metric tons/gallon of gasoline) x (19,135,845 miles traveled by APHIS-WS) x (1/21.5 mpg) x (1/0.985)

17 Conklin and deDecker Aviation Information (https://www.conklindd.com/CDALibrary/CO2Calc.aspx) fixed-wing aircraft. Average fuel consumption rates for fixed wing piston engine aircraft is 12.9 gph (FAA 2005). Average CO_2 emissions for piston engine aircraft are 0.11 MT/hr (Conklin and de Decker 2015). Less than one percent each of NOx, CO, SOx, and other trace components are emitted from aircraft engine emissions (FAA 2005).

18 CEQ issued a memorandum to heads of federal agencies and departments on February 28, 2011, providing draft guidance on when and how to analyze the environmental impacts of greenhouse gas emissions and climate change under NEPA. A suggested 25,000 metric tons of carbon dioxide equivalent emissions from the proposed action would trigger the need for a quantitative analysis.

is anticipated to result in substantial changes that would impact national APHIS-WS greenhouse gas emissions.

Consequently, WS-Utah program activities likely to result from the proposed action would have a negligible effect on atmospheric conditions including the global climate

2.5.5 Livestock Losses Should Be an Accepted Cost of Doing Business

WS is aware of concerns that federal wildlife damage management should not be allowed until economic losses reach an identified threshold of loss or become unacceptable. Although some losses of livestock and poultry can be expected and are tolerated by livestock producers, APHIS-WS has the legal direction to respond to requests for wildlife damage management, and it is APHIS-WS policy to aid each requester to minimize losses.

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

Some members of the public have suggested that livestock grazing is *connected* to WS PDM action, which implies that it either is an *interdependent part* of WS PDM and depends on such PDM for its justification, that it is *automatically triggered* by WS PDM, or that it *cannot and will not proceed* unless WS PDM occurs (40 CFR 1508.25). All of these assertions are false.

Livestock grazing in Arizona occurs on many private property areas, as well as on BLM and USFS grazing allotments, without any WS PDM actions conducted on those allotments in a given year. Therefore, livestock grazing is not automatically triggered by WS PDM, and it clearly can and does proceed in the absence of WS PDM assistance.

Some public commenters assert that WS PDM to protect livestock cannot or will not proceed unless livestock grazing is occurring. WS does not believe this view to be a logical one. If there were no raising of livestock at all in this country, then there would be no PDM activities to protect livestock. There would be no reason for WS to conduct PDM for livestock protection if there were no livestock to protect against predators. Furthermore, there would be no PDM actions if there were no predators of livestock. Normally, PDM activities will occur wherever livestock producers request PDM assistance whether it is on private land or on state or federal public lands and whether or not WS is specifically requested to do the PDM actions. Since federal agencies do not have the authority to regulate private land livestock grazing, such grazing and its effects are part of the existing human environment (*i.e.*, *environmental status quo*) and such private land livestock grazing is quite common and extensive.

Livestock grazing does not occur and does not proceed because WS PDM occurs. Predators oftentimes travel from an area of one land ownership where livestock are not present into an area of another land ownership where livestock are present to prey on the livestock. Therefore, there does not have to be any livestock grazing on BLM or FS lands to potentially still have some PDM activities on those lands for the purposes of protecting livestock on private lands that are in relative close proximity to or directly bordering on public lands.

Federal laws governing the management of lands administered by the BLM and USFS, including the National Forest Management Act, Multiple-use Sustained Yield Act of 1960, 16 USC § 528, and Federal Land Policy Management Act, 43 USC § 1732(b), require BLM and USFS to allow for and to manage livestock grazing on BLM and USFS lands. For areas of federally designated wilderness under the jurisdiction of the BLM and USFS, the Wilderness Act, Pub. L. 88-577, 78 Stat. 890, 16 USC §§ 1131 et seq., allows for the continuation of grazing operations in federally designated WAs where grazing took place prior to the area's designation as wilderness. Thus, BLM and USFS, and not WS, have the authority to regulate and restrict grazing and to control the effects of grazing on riparian areas and on rangeland and forest wildlife habitat in general on federal public lands. No federal agency has authority to restrict livestock grazing on nonfederal lands.

Livestock grazing activities that are authorized by federal land management agencies to occur on federal lands are subject to NEPA requirements. The BLM and USFS prepare NEPA documents covering their authorizations of livestock grazing on federal public lands and we refer the reader to environmental documents prepared by those agencies for further information and analysis of the environmental effects of grazing.

Improperly controlled livestock grazing can lead to undesirable indirect effects on certain wildlife species by causing changes in rangeland habitat, including riparian areas. Regulation or restriction of livestock grazing is outside the scope of decisions that WS has authority to make. Thus, livestock grazing on all land ownership classes where it now occurs (private, state or federal lands), and whatever impacts there might be from such grazing, are part of the *environmental status quo* whether or not WS conducts any PDM activities. As stated earlier, PDM methods used by WS actions have no direct effect on riparian areas, rangeland, or other types of habitat. Therefore, WS PDM activities do not contribute to any cumulative impact on riparian areas or other habitat areas that are being affected or have been affected by livestock grazing.

Although some persons may view WS PDM actions as causing indirect effects on rangeland and riparian areas by facilitating the continuation of livestock grazing in such areas, as discussed above, such livestock grazing now takes place and there is no reason to think it will not continue to take place, with or without PDM assistance from the WS program. For example, grazing occurs now on most BLM and USFS grazing allotments in the state without assistance from WS on those allotments. Thus, the majority of livestock grazing activity on public federal lands in Arizona is not receiving any WS-Arizona PDM assistance and such grazing is part of the existing *environmental status quo*.

As long as livestock producers experience serious economic losses from predators, some of them will continue to employ PDM actions to counter or prevent such losses whether or not WS-Arizona continues to conduct PDM actions. In the absence of any involvement by WS-Arizona, the livestock owners and managers or authorized state agencies will conduct PDM on their own. Currently, livestock producers, private resource owners, and state agencies that request WS-Arizona PDM actions in Arizona must cover about 50% of WS-Arizona's costs for providing the PDM service. Even if some livestock producers went out of business from the lack of receiving any PDM assistance and, thereby, from significant losses resulting from predation, that does not mean that livestock grazing would not continue. Some such producers would be expected to sell their ranches, including, where applicable, any associated federal grazing permits, to other producers that may have better economic ability to withstand predation losses. However, it is also possible that other such producers that go out of business may sell their properties to land developers, which can then lead to reductions in wildlife habitat because of rural land subdivision and residential housing construction. When that occurs, the inability to obtain adequate PDM services could have the unintended consequence of leading to reductions in wildlife species that formerly lived on, or otherwise depended on, the habitat that was lost to development. Loss of habitat because of human population growth and expansion of housing into traditional habitat areas has been a major concern of wildlife biologists in evaluating causes of long term declines in wildlife numbers since the middle part of the last century.

Like livestock grazing and its impacts on the environment, PDM by nonfederal (private or state) entities is part of the environmental status quo for the human environment in the absence of any federal PDM assistance and does not have to comply with the requirements and provisions of NEPA. However, such PDM actions by private or nonfederal parties could result in unacceptable and harmful impacts. We believe it is reasonable to expect that professional assistance by a federal government agency operating in compliance with all federal and state laws and government policies and guidelines is less likely to result in unintended adverse effects on the environment in general, and more specifically on non-target wildlife and HHS than would nonfederal entities. Evidence exists to suggest some private entities are even likely to resort to illegal chemical pesticide uses in attempts to resolve real or perceived wildlife damage problems (USFWS 1996b, 2003, Texas Department of Agriculture 2006, Porter 2004).

PDM actions by private or nonfederal parties are not governed or restricted by the same environmental laws by which federal government agencies must abide by such as NEPA and the preventive measures consultation requirements of Section 7 of the ESA. However, Private and nonfederal parties conducting PDM on federal land still are required to abide by environmental laws including Section 7 ESA consultation requirements. Thus, curtailing or greatly restricting WS-Utah PDM assistance could lead to the unintended but real and significant effect of greater adverse environmental impacts caused by private or nonfederal parties performing PDM actions. It is apparent that, at least with respect to federal public lands, livestock grazing is regulated with the goal of reducing the severity of adverse impacts on wildlife and other environmental resources (see BLM and USFS EIS documents for each National Forest or Resource Management Area), just like WS-Utah takes into account the impacts on wildlife and other environmental resources by its PDM actions.

It is certainly reasonable to assume that PDM by state or private entities would occur in the absence of assistance by WS-Utah. This means that even if someone asserts that WS-Arizona PDM for livestock protection is *connected* to public land grazing, WS-Utah has no ability to affect the environmental outcome because most such grazing will continue to occur on public lands anyway, and at least some level of PDM will most likely occur also, in the absence of any action by WS-Utah. Thus, even if WS-Utah decided to select the No Federal PDM Program Alternative (Alternative 1), such a decision would have virtually no meaningful effect in changing the *environmental status quo* with respect to the impacts of grazing and/or PDM actions. The federal land management laws such as the National Forest Management Act, Multiple-use Sustained Yield Act, Federal Land Policy Management Act, and Wilderness Act contain clauses protecting the rights of the states to maintain jurisdiction over the management of resident wildlife species[19]. It is our understanding that, unless regulated or restricted by the BLM or USFS, authorized Utah state agencies such as the UDWR and UDAF (or even private entities acting in accordance with state wildlife laws) could theoretically be authorized to control predators on BLM and USFS lands in the absence of any involvement by WS-Utah.

2.5.7 Concerns that Killing Wildlife Represents "Irreparable Harm"

Some members of the public have suggested that the killing of any wildlife represents irreparable harm because of the loss of individual animals. Although an individual predator or multiple predators in a specific area may be killed by WS 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. Utah's historic and current populations of big game animals, game birds, furbearers and predators, which annually sustain harvests of animals as part of the existing human environment, are obvious testimony to the fact that the killing of wildlife does not cause irreparable harm. Populations of some of these species are in fact much higher today than they were several decades ago (e.g. elk and mountain lions). The legislatively mandated mission of UDWR is to conserve Utah's diverse wildlife resources and manage for safe, compatible outdoor recreation opportunities for current and future generations. Therefore, UDWR would be expected to regulate harvest of wildlife in the state to avoid irreparable harm. Our analysis herein shows that the species WS-Utah takes in PDM actions have no negative impacts to maintaining sustainable and viable populations. Thus, losses due to human-caused mortality are not *irreparable.*

2.5.8 Concerns that WS Personnel Might Unknowingly Trespass

WS is aware that it is sometimes difficult to determine land ownership in some areas, and WS 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 typically provide WS 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 aerial PDM activities are typically conducted with the aerial crew in radio contact with a WS representative on the ground who knows the property boundaries of the area being worked. Therefore, we do not expect that inadvertent trespass incidents would rise to the level of presenting any significant environmental effects.

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

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

Public comments have raised the concern that the mere presence of WS 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. There are fewer than 25 WS field personnel in Arizona, which is only a minimal fraction of the thousands of public recreationists and other public land users that go onto public lands in any one year as part of the existing human environment. WS-Arizona abides by any area closures imposed by state or federal land or wildlife management agencies to protect sensitive wildlife species. We rely upon annual coordination with those same agencies to alert us to areas where this is of particular concern. In general, few if any such concerns have been raised by the responsible agencies because WS-Utah personnel only work in a small proportion of the land area and spend little time in any particular area.

2.5.10 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 using 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 that requires multiple use of federal lands such as livestock grazing, 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-Utah is cooperatively funded including monies from 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-Utah 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-Utah 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-Utah 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 (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 does not allow for livestock losses to be deducted if the killed livestock was produced on the ranch and not purchased from an outside source (IRS 2016). In the western United States, a large proportion of predation occurs to young livestock (lambs, kids, and calves), and many adult ewes, nannies, and cows are added as breeding stock replacements to herds from the year's lamb, kid, and calf crop. Any of these animals lost to predation cannot be "written off" since they were not purchased. These factors limit the ability of livestock producers to recover financial losses through tax deductions.

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

2.5.11 Livestock Producers Should Pay All Costs of PDM

The Act of 1931, as amended, authorizes the Secretary of Agriculture to make expenditure of resources for the protection of agricultural resources. Congress makes annual allocations to APHIS-WS for the continuing federal action of WDM, including PDM. Congress further establishes that APHIS-WS may receive and retain funds provided by other entities (e.g., States, industry, public and private funds) and use them towards those programs from which funds were received. In FY16, the funds used by WS-Utah were 50% state (state head tax), 32% federally appropriated, 14% private, and 4% federal cooperative funds; cooperators pay the costs of nonlethal actions taken, even when recommended by WS-Utah personnel.

Rather than address this issue in the EA, this issue is appropriately addressed through political processes at the federal levels.

2.5.12 A Program Subsidizing Nonlethal Methods Implemented by Resource Owners Should Replace APHIS-WS PDM

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

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

2.5.13 Incorporate the Environmental Costs of Livestock Grazing on Public Lands into the EA Analyses

Commenters have requested that APHIS-WS consider the environmental costs of grazing on public lands and other activities in the EA 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 for private lands as well. APHIS-WS only responds to requests for assistance, and uses the APHIS-WS Decision Model (WS Directive 2.201) 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.

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

UDWR has identified limited circumstances where PDM for the protection of native game species such as mule deer, bighorn sheep and greater sage-grouse, especially related to mountain lion predation, would meet UDWR objectives. UDWR conducts the removal of offending animals, or hires WS-Utah or commercial WDM companies, or it can certify, train, and use volunteer agents. APHIS-WS policy and objectives are to consider and respond appropriately to all requests for PDM assistance. Data collected as part of UDWR's mountain lion removal actions in limited areas of the state for the protection of game species, as well as for protection of livestock on private lands and human health and safety, indicate that the mountain lions removed have not, and will not, result in non-sustainable mountain lion populations. Preliminary studies by UDWR indicate that mountain lion removals, including those from UDWR and WS-Utah acting as an agent for UDWR, may have been effective in improving the viability and health of vulnerable ungulate and bighorn sheep populations (UDWR Statewide Management Plan for Bighorn Sheep 2008). WS-Utah ultimately decides when it is appropriate to enter into agreements with UDWR to assist with meeting state game management objectives.

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

2.5.15 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 Utah, the primary responder to damage caused by dogs is either a local animal control authority or the Utah State Police. However, WS-Utah 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-Utah 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-Utah 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-Utah 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. If the dog has identification allowing determination of the owner, the owner is informed as soon as possible. If unable to make contact with the dog owner and the dog is not harmed the dog is released on site.

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

2.5.16 More Time and Money should be spent on Education

Education is an important element of WS-Utah program because WDM is about finding a "balance" or co-existence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather, is in continual flux. In addition to the dissemination of educational materials and recommendations to individuals or organizations sustaining damage, lectures and demonstrations are provided to ranchers, homeowners, and other interested groups. WS-Utah frequently cooperates with other agencies in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that WS-Utah personnel, other wildlife professionals, and the public are updated on recent developments in damage management technology, laws and regulations, and agency policies.

2.5.17 WS-Utah PDM Impacts on Aesthetics

Aesthetics is a philosophy dealing with the nature of beauty or the appreciation of beauty. Therefore, aesthetics is subjective in nature and is dependent on what an observer regards as beautiful. Wildlife generally is regarded as providing economic, recreational and aesthetic benefits (Decker and Goff 1987) and the mere knowledge that wildlife exists is a positive benefit to many people. There may be some concern that the proposed action or alternatives would result in the loss of aesthetic benefits to the public, resource owners or neighboring residents. WS-Utah Operating policies discussed in section 3.5 are used to minimize WS-Utah's impacts on Aesthitics.

WS-Utah PDM activities occur on a relatively limited portion of the total area in Arizona, and the portion of various predator species' populations removed through WS-Utah PDM activities is typically low (see Chapter 4). In localized areas where WS-Arizona removes some portion of the predator population, dispersal of predators from adjacent areas typically contributes to repopulation of the area within a few weeks to a year, depending on the level of predator removal and predator population levels in nearby areas. Most of the species potentially affected by WS-Utah PDM activities are relatively abundant, but are not commonly observed because many of these species are secretive and nocturnal. The likelihood of getting to see or hear a predator in some localized areas could be temporarily reduced as a result of WS-Utah 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. Impacts of WS-Utah PDM on overall predator populations would be relatively low under any of the alternatives being considered in this EA, and opportunities to view, hear, or see evidence of predators would still be available over the vast majority of public land areas of the state since WS-Utah conducts PDM on a small percentage lands.

CHAPTER 3: ALTERNATIVES AND OPERATING POLICIES

3.1. INTORDUCTION

This chapter consists of four parts: 1) an introduction, 2) description of alternatives considered and analyzed in detail including the Proposed Action (Alternative 1), 3) a description of alternatives considered, but eliminated from detailed study, and 4) a discussion of SOPs. Five alternatives were recognized, developed, and analyzed in detail by the MAT (WS-Utah, BLM, Forest Service, UDWR, UDAF); four alternatives were considered but not analyzed in detail with supporting rationale. The five alternatives analyzed in detail are:

Alternative 1 – Continue the Current Utah Adaptive Integrated PDM Program No Action /Proposed Alternative).

This alternative consists of the current program of technical assistance and operational Adaptive IWDM (WS Directive 2.105) by WS-Utah on BLM, Forest Service, State, county, municipal and private lands under Cooperative Agreement, *Agreement for Control*, and/or Work Plans with WS-Utah. The current program direction is for the protection of livestock, poultry, crops, designated wildlife, property, and public health and safety. Protection of public health and safety from black bear or mountain lions is conducted at the request of the UDWR and includes only corrective PDM.

Alternative 2 – WS-Utah Operational Lethal Strategies for Corrective PDM Only.

This alternative would require that depredation or damage (*i.e.,* livestock, wildlife, property), or human injury or death (*i.e.,* human health and safety) occur before the initiation of lethal damage management. However, WS-Utah would provide technical assistance for nonlethal preventative methods to reduce predation/damage on protected resources to requesting entities.

Alternative 3 – Nonlethal Damage Management Only.

Under this alternative, only nonlethal technical assistance and operational damage management would be provided by WS-Utah.

Alternative 4 -Technical Assistance Only.

Under this alternative, WS-Utah would not conduct any operational PDM in Utah. The entire program would consist of only recommendations and technical assistance.

3.2. DESCRIPTION OF THE ALTERNATIVES

3.2.1 Alternative 1 – Continue the Current Utah Adaptive Integrated PDM Program (No Action/Preferred Alternative) Summary.

The No Action alternative is a procedural NEPA requirement (40 CFR 1502.14(d)), is a viable and reasonable alternative that could be selected, and serves as a baseline for comparison with the other alternatives. The No Action Alternative, as defined here, is consistent with CEQs definition (CEQ 1981).

This alternative would continue the current WS-Utah adaptive IWDM program for the protection of livestock, poultry, crops, designated wildlife, property and public health and safety in Utah. The current program is a collection of cooperative programs with other federal, state and local agencies, and private individuals and associations to protect livestock, poultry, crops, property, designated wildlife and public health and safety (described in Chapter 1). WS-Utah conducts technical assistance, preventive (in response to historical loss) and corrective (in response to current loss or hazard) operational PDM on BLM, National Forest System, State, county and private lands under MOU, Cooperative Agreements or *Agreement for Control*, or Work Plans. Mountain lion and bear damage management for livestock protection is corrective PDM only, consistent with policies ADWPB and the UWB. All PDM is based on interagency relationships, which require close coordination and cooperation because of overlapping authorities.

On federal lands, WS-Utah Work Plans describe the PDM that would occur. During the WS-Utah planning process with the BLM and Forest Service, plans are prepared which describe and delineate where PDM may be conducted and what methods may be used. Before management is conducted on private lands, *Agreements for Control on Private Property* are signed with the landowner or administrator that describe the methods to be used and the species to be managed. Management is directed toward localized predator populations and/or individual offending animals, depending on the circumstances.

PDM would be conducted in designated WAs, WSAs, PAs or ISAs when allowed by the legislation designating the area or under regulations developed by the Forest Service or BLM. PDM in these designated areas is only a small portion, and expected to continue to be a very limited portion, of the current program.

Under the current program, PDM for the protection of wildlife may be conducted at the request of the UDWR or USFWS, and could be coordinated with livestock protection projects. This alternative proposes to combine a WS-Utah livestock protection program with potential needs to protect designated wildlife resources, following consultation with UDWR and in coordination with the UDWR and USFWS (to address T&E species concerns). Mountain lion and black bear damage management would be conducted consistent with UWB policy (UDWR 2015, UDWR 2011). PDM strategies, including areas to where management may be conducted, timing of damage management and methods to be used would be selected based on the combined needs of livestock and wildlife resources, rather than just the needs of the livestock resources,. This strategy provides for an ecosystem management approach for areas where WS-Utah conducts PDM. For any specific area of public land, the UDWR and/or USFWS would be invited to attend the Work Plan meeting between WS-Utah and the BLM or the Forest Service. WS-Utah would identify areas where requests for assistance to protect livestock have been received or are anticipated (based on historic losses). The UDWR or USFWS would identify areas where protection of wildlife may be necessary to achieve their management objectives. The land management agency, would identify areas where other mitigation is necessary to protect resources under their jurisdiction. A damage management strategy would then be developed based on the combined resources needs, and the necessary minimization measures.

WS-Utah may assist the UDWR investigate human health and safety requests related to black bear or mountain lion. State policies direct the appropriate response to these requests and the decision as to the fate of the animal(s) involved rests with the UDWR. WS-Utah will respond to UDWR requests for assistance in capturing black bears or mountain lions and will use the Decision Model (Slate et al. 1992) to determine the appropriate methods to be used.WS-Utah will respond within its program authorities to human safety requests regarding coyotes or red fox and will apply the Decision Model (Slate et al. 1992) to decide methods, timing and fate of the animal(s) involved. Mechanical and chemical management tools described for Alternative 1 would apply, where appropriate, under this alternative (Appendix E).

3.2.2 Alternative 2 – WS-Utah Operational Lethal Strategies for Corrective PDM And Technical Assistance

This alternative would only provide for PDM in places where livestock, poultry, crops, property or wildlife depredations have occurred, or only after human health and safety has been compromised from a predator attack (*i.e.,* injury or death to a human). Incumbent in this alternative is WS-Utah verification of the loss of a resource or threat to human health and safety and the species responsible. Livestock producers could still implement nonlethal methods they determine to be practical and effective or as recommended by WS-Utah. Lethal PDM would be limited to an area near the depredation site to maintain the integrity of the corrective only situation. The full variety of mechanical and chemical methods described in Appendix E would be available, once losses have occurred and are verified.

3.2.3 Alternative 3 – Nonlethal Predator Damage Management Only

Under this alternative, WS-Utah would only use nonlethal methods or only provide technical assistance regarding nonlethal techniques, except when emergency damage management is necessary for public safety. WS-Utah would encourage or recommend to resource owners to use livestock guarding dogs and other nonlethal methods which could include husbandry, localized habitat modification, fencing, and electronic guards/frightening devices (Appendix E). In accordance with state law and as directed by state legislature the UDAF would continue to use IWDM that would include lethal control as a component even if WS-Utah is not involved.

3.2.4 Alternative 4 - Technical Assistance Only

This alternative would eliminate WS-Utah operational PDM. WS-Utah would only provide technical assistance and make recommendations when requested. However, private landowners, contractors, or others could conduct their own PDM on federal, state, county and private lands. WS-Utah's 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-Utah would then provide the cooperator with information on appropriate non-lethal and lethal methods to alleviate the damage themselves. This would effectively preclude the use of certain methods, such as M-44s, by state agencies, other federal agencies or private individuals, due to constraints on the use of these methods by other state or federal regulatory agencies.
For non-lethal methods, this Alternative would not be substantially different from Alternative 1, because most non-lethal methods are implemented by the cooperator. The major difference under Alternative 4 is that WS-Utah would not conduct operational lethal PDM. Many cooperators rely on these services from WS-Utah because they lack the technical expertise to implement these methods on their own, are prohibited by state or federal regulatory agencies from using the method (e.g., M-44's) or from using the method on public land, or it is more cost-effective to work with WS-Utah. Under Alternative 4, cooperators would need to conduct these methods on their own, or hire other entities or individuals to conduct these methods. This would limit the lethal methods available for use. This alternative would place the immediate burden of operational damage management on other federal or state agencies, individuals, and livestock producers. Individuals experiencing wildlife damage would, independently or with WS-Utah recommendations, carry out and fund damage management activities. Individual producers could implement PDM as part of the cost of doing business, or a state agency could assume a more active role in providing operational PDM.

If this alternative was selected, WS-Utah could not direct how a state agency or individuals would implement PDM. Some agencies or individuals may choose not to take action to resolve wildlife damage. Other situations may warrant the use of legally available management methods because of public demands, mandates, or individual preference. Methods and damage management devices could be applied by people with little or no training and experience, and with no professional oversight or monitoring for effectiveness or safety. This in turn could require more effort and cost to achieve the same level of problem resolution, and could cause harm to the environment, including a potentially higher take of nontarget animals. The illegal use of pesticides could increase which would be extremely detrimental to wildlife (Schueler 1993, Allen et al. 1996).

WS-Utah would have no responsibility for any lethal actions implemented by the requester upon advice and recommendations from agency personnel. State agencies or private companies would need to provide all operational PDM to assist livestock producers. The livestock producer would be responsible for compliance with the Endangered Species Act and all other federal, tribal, state, and local laws and regulations associated with PDM.

Table 3-1. Methods Recommended or Used by WS-Utah For Each Alternative.

Method	1	2	3	4	5
Exclusion	X		X	X	
Scare Devices	X		X	X	
Cultural Prac.	X		X	X	
Local Hab. Mod	X		X	X	
Leg-hold Trap	X	X	X		
Snares	X	X	X		
Ground Shoot	X	X			
Hunting Dogs	X	X			
Denning	X	X			
Aerial Gunning	X	X			
M-44	X	X			
LPC	X	X			
Euthanasia	X	X			

3.3 DETAILS OF THE PREFERRED ALTERNATIVE

Since its formation, APHIS-WS has considered, developed, and used numerous methods to reduce damage problems). The efforts have involved the research and development of new methods, and the implementation of effective strategies to resolve wildlife damage.

The most effective approach to resolving wildlife damage is to integrate the use of several methods simultaneously or sequentially. IWDM is the implementation and application of safe and practical methods for the prevention and reduction of damage caused by wildlife based on local problem analyses and the informed judgment of trained personnel. The WS-Utah Program applies IWDM, sometimes referred to as Integrated Pest Management (WS Directive 2.105), to reduce damage using the WS Decision Model (Slate et al. 1992).

The philosophy behind IWDM is to implement effective management techniques, in a cost-effective manner while minimizing the potentially harmful effects to humans, target and nontarget species, and the environment. IWDM draws from the largest possible array of options to create a combination of appropriate techniques for the specific circumstances. IWDM may incorporate cultural practices (*i.e.,* animal husbandry), localized habitat modification, animal behavior (*i.e.,* scaring), local population reduction, or any combination of these, depending on the characteristics of the specific damage problems.

3.3.1 IWDM Strategies Available for use by WS-Utah

Technical Assistance/Education and Outreach

"Technical assistance", as used herein, is information, demonstrations, and/or advice on available and appropriate WDM methods and approaches. The implementation of damage management actions is the responsibility of the requester. In some cases, WS-Utah provides supplies or materials that are of limited availability for use by non-WS-Utah entities. Technical assistance may be provided through a personal or telephone consultation, or during an on-site visit with the requester. Generally, several management strategies are described to the requester for short and long-term solutions to damage problems. These strategies are based on the level of risk, need, and the practicality of their application. In some instances, wildlife-related information provided to the requestor by WS-Utah results in tolerance/acceptance of the situation. In other instances, management options are discussed and recommended. Entities are not required to implement WS-Utah recommendations and may choose to take no action, seek additional guidance or operational assistance from other sources and implement strategies other than those developed with WS-Utah.

Education is an important element of WS program activities because WDM is about finding balance and coexistence between the needs of people and needs of wildlife. This is extremely challenging as nature has no balance, but rather, is in continual flux. In addition to the routine dissemination of recommendations and information to individuals or organizations sustaining damage, lectures, instructional courses, and demonstrations are provided to producers, homeowners, state and county agents, colleges and universities, and other interested groups. WS-Utah frequently cooperates with other agencies in education and public information efforts. Additionally, technical papers are presented at professional meetings and conferences so that WS-Utah personnel, other wildlife professionals, and the public are periodically updated on recent developments in damage management technology, programs, laws and regulations, and agency policies.

Operational Damage Management:

Direct damage management assistance includes damage management activities that are directly conducted or supervised by WS-Utah personnel. Direct damage management assistance may be initiated when the problem cannot effectively be resolved through technical assistance alone and when a *Work Initiation Document for Wildlife Damage Management* or other comparable instruments provide for direct damage management by WS-Utah. The initial investigation defines the nature, history, and extent of the problem; species responsible for the damage; and methods available to resolve the problem. The professional skills of WS-Utah personnel are often required to effectively resolve problems, especially if restricted use pesticides are necessary or if the problems are complex. The recommended strategy(ies) may include any combination of preventive and corrective PDM that could be implemented by the requester, WS-Utah, or other agency personnel, as appropriate. Two strategies are available:

Preventive Damage Management:

Preventive damage management is the application of PDM strategies before damage occurs, based on historical damage problems. As requested and appropriate, WS-Utah personnel provide information and conduct demonstrations, or take action to prevent these historical problems from recurring. For example, in areas where substantial lamb depredations have occurred on lambing grounds, WS-Utah may provide information about livestock guarding dogs, fencing or other husbandry techniques, or be requested to conduct PDM before lambing. For PDM on federal lands, historical loss areas are delineated in Work Plans, which identify areas where preventive PDM could occur. In addition, when conducting PDM, WS-Utah must also receive a request from the livestock owner or individual experiencing the damage. Management areas and techniques are reviewed during the Work Plan meeting between the appropriate agencies.

Corrective PDM: Corrective PDM is the application of PDM strategies to stop or reduce current losses. As requested and appropriate, WS-Utah personnel provide information and conduct demonstrations, or take action to prevent additional losses from ocurring[20]. For example, in areas where verified and documented livestock depredations are occurring, WS-Utah may provide information about livestock guarding dogs, fencing or animal husbandry techniques, or conduct operational damage management to stop the losses.

3.3.2 Research and Development.

The National Wildlife Research Center (NWRC) functions as the research arm of APHIS-WS by providing scientific information and development of methods for WDM that are effective and environmentally responsible. National Wildlife Research Center scientists work closely with wildlife managers, researchers, field specialists and others to develop and evaluate WDM techniques. National Wildlife Research Center scientists have authored hundreds of scientific publications and reports, and are respected world-wide for their expertise in WDM.

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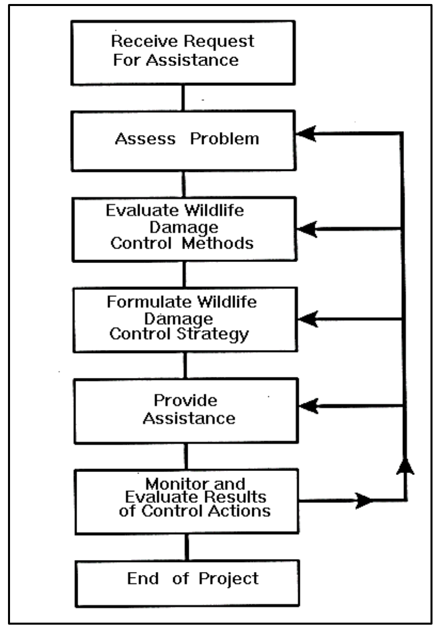
21 Removal of coyotes may benefit sage-grouse populations, as coyotes were identified as one of predators of grouse (Stinson et al. 2004).

3.4 WS DECISION MAKING PROCESS



WS-Utah personnel use a thought process for evaluating and responding to damage complaints which is depicted by the WS Decision Model and described by Slate et al. (1992) (Figure 3-1). WS-Utah personnel are frequently contacted after requesters have tried or considered nonlethal methods and found them to be impractical, too costly, or inadequate to reduce damage. WS-Utah personnel assess the problem then evaluate the appropriateness and availability (legal and administrative) of strategies and methods based on biological, economic and social considerations. Following this evaluation, methods deemed to be practical for the situation are incorporated into a management strategy. After this strategy has been implemented, monitoring is conducted and evaluation continues to assess the effectiveness of the strategy. If the strategy is effective, the need for further management is ended. In terms of the APHIS-WS Decision Model (Slate et al. 1992), most damage management efforts consist of continuous feedback between receiving the request and monitoring the results of the damage management strategy. The Decision Model is not a written documented process, but a mental problem-solving process common to most, if not all, professions.

3.4.1 Community-based Decision Making

The WS-Utah program follows the "co-managerial approach" to solve wildlife damage or conflicts as described by Decker and Chase (1997). Within this management model, WS-Utah could provide technical assistance regarding the biology and ecology of mammals and effective, practical, and reasonable methods available to the local decision-maker(s) to reduce damage or threats. This could include nonlethal and lethal methods depending on the alternative selected. WS-Utah and other state, tribal and federal wildlife management agencies may facilitate discussions at local community meetings when resources are available.

Requests for assistance to manage damage caused by mammals often originate from the decision-maker(s) based on community feedback or from concerns about damage or threats to human safety. As representatives of the community, the decision-maker(s) are able to provide the information to local interests either through technical assistance provided by WS-Utah or through demonstrations and presentation by WS-Utah on PDM activities. This process allows decisions on PDM activities to be made based on local input. They may implement management recommendations provided by WS-Utah or others on their own, or may request management assistance from WS-Utah, other wildlife management agencies, local animal control agencies, or private businesses or organizations.

Community Decision-Makers

The decision-maker for the local community would be elected officials or representatives of the community. The elected officials or representatives are popularly elected residents of the local community or appointees who oversee the interests and business of the local community. This person or persons would represent the local community's interest and make decisions for the local community or bring information back to a higher authority or the community for discussion and decision-making. Identifying the decision-maker for local business communities is more complex because building owners may not indicate whether the business must manage wildlife damage themselves, or seek approval to manage wildlife from the property owner or manager, or from a governing Board. Wildlife Services could provide technical assistance and make recommendations for damage reduction to the local community or local business community decision-maker(s). Direct control could be provided by WS-Utah only if requested by the local community decision-maker, funding is provided, and if the requested direct control was compatible with WS-Utah recommendations.

3.4.2 Private Property Decision-Makers

In the case of private property owners, the decision-maker is the individual that owns or manages the affected property. The decision-maker has the discretion to involve others as to what occurs or does not occur on property they own or manage. Due to privacy issues, WS-Utah cannot disclose cooperator information to others. Therefore, individual property owner or managers make the determinations regarding involvement of others in the decision-making process for the site. Direct control could be provided by WS-Utah if requested, funding is provided, and the requested management is in accordance with WS-Utah recommendations.

The decision-maker for local, state, or federal property would be the official responsible for or authorized to manage the public land to meet interests, goals, and legal mandates for the property. Wildlife Services could provide technical assistance to this person and recommendations to reduce damage. Direct control could be provided by WS-Utah if requested, funding provided, and the requested actions were within the recommendations made by WS-Utah. Public involvement would be conducted by the agency responsible for managing the site in accordance with agency procedures.

3.4.3 Tribal Decision-Makers

The decision-makers for Tribal property and ceded territories would be the officials responsible for or authorized to manage the Tribal lands and the lands / and or resources identified under treaty rights, to meet interests, goals, and legal mandates for the property. Wildlife Services could provide technical assistance and recommendations to reduce damage. Direct control could be provided by WS-Utah if requested, funding provided, and the requested actions were within the recommendations made by WS-Utah. Involvement of tribal members or members of the surrounding community would be conducted in accordance with the established regulations and procedures for the affected tribe(s).

3.5. WS-UTAH OPERATING POLICIES

WS-Utah uses Operating Policies to prevent or minimize project related negative effects on the environment (section 4.4.1.2). For the purposes of this EA, those measures are termed SOPs. The key SOPs are incorporated into all alternatives as applicable, except the no federal program alternative (Alternative 2). Most SOPs are instituted to abate specific issues while some are more general and relate to the overall program.

3.5.1 General Operating Policies

- WS-Utah activities are in compliance with applicable guidance established in USFS LRMPs, BLM RMPs, and management guidelines for WSAs (BLM 2012).

- National MOUs with the BLM and USFS delineate expectations for PDM on public lands administered by these agencies. WS-Utah AWPs are developed in coordination with BLM, USFS and UDWR. AWPs detail activities, target species and SOPs to be implemented on allotments where PDM is needed and requested. This minimizes potential impacts on recreational and cultural resources, public hunting, sensitive species, wildlife viewing and other multiple land uses (Directive 2.210).

- WS-Utah would not conduct any work on tribal reservations without prior consent of and consultation with Tribal officials to identify and resolve any issues of concern. At the request of federally recognized tribes, WS-Utah will consult with tribes regarding actions that are not on tribal lands but within ceded territory for the tribe (See also Section 3.2.8).

- WS-Utah employees will conform to MOU's established with state management agencies (UPDMB, UDWR, USFWS and BLM) as guidance to trapping policies or WS Directive 2.210.

- Pesticide use complies with EPA rules and regulations administered by UDAF (Directive 2.401).

3.5.2 Specific Operating Policies

The following is a summary of Operating Policies that are specific to the issues listed in Chapter 2 of this document.

3.5.2.1 Effects on target predator species populations

- Depending upon the species and magnitude of the problem, PDM is directed towards localized depredating populations (e.g., coyotes) or individual offending animals (e.g., black bears and mountain lions) and is never an attempt to eradicate the populations in the entire area or region (Directive 2.105).

- WS-Utah personnel use specific trap types, lures and placements that are most conducive for capturing the target animal (Directives 2.450 and 2.4755).

- WS-Utah monitors all available population information on target and nontarget species covered in this EA. Consideration of "Total Harvest" and estimated population numbers of key species are used to assess cumulative effects to maintain the magnitude of harvest below the level that would impact the viability of populations of native species (see Chapter 4). WS-Utah provides data on total take of target animal numbers to BLM and USFS during annual coordination meetings and to UDWR through annual reports. These reports may also be provided to federally-recognized tribes at the tribe's request. For federal listed species, WS-Utah notifies UDWR and USFWS of take within 24 hours.
- WS-Utah personnel use The WS Decision Model (Directive 2.201) for selecting the appropriate PDM strategy.

- ATOC's primary focus is to provide pilots and crewmembers with guidance and training for all APHIS-WS personnel and aerial activities. ATOC is authorized to lethally take coyotes during training activities in Utah as part of WS-Utah PDM. ATOC's PDM operations that involve direct control (take) of coyotes in Utah will only occur in areas under signed WS agreements, MOU's or Federal Agency Annual Work Plan Agreements. All of ATOC's lethal take of coyotes will be recorded in the Management Information Systems (MIS) under the appropriate agreement.

3.5.2.2 Effects on nontarget species populations, including T&E species

- WS-Utah personnel are highly experienced and trained to select the most appropriate method(s) for taking problem animals with little impact on nontarget animals (Directives 2.201 and 2.310).

- Traps and snares are not set within 30 feet of exposed bait or animal carcasses to prevent the capture of eagles, other raptors and scavenging birds (Directive 2.450). The only exception to this APHIS-WS policy is for the capture of mountain lions, black bears and wolves because the weight of these target animals adequately allows foot capture device tension adjustments to exclude the capture of smaller nontarget animals (Directive 2.450).

- Foot snare trigger and foothold trap under pan tension devices are used, as appropriate, by WS-Utah to reduce the capture of nontarget wildlife that weigh less than the target species (Directive 2.450).

- Breakaway snares (i.e., these are snares that have locks designed to break open and release with 250 to 320 foot pounds of tension, which is what would be exerted by larger nontarget animals such as deer, antelope and livestock) have been developed. These snares have been implemented into WS-Utah and are used, as appropriate (Directive 2.450).

- Nontarget animals captured in foothold traps or foot snares are released at the capture site unless it is determined by WS-Utah personnel that the animal is not likely to survive, whereupon it will humanely euthanized (Directive 2.450).

- WS-Utah personnel use specific trap types, lures and placements that are conducive to capturing the target animal, while minimizing potential impact on nontarget species (Directive 2.450).

- WS-Utah personnel work with the National Wildlife Research Center (NWRC) and other research programs to continue to improve the selectivity of management devices and development of nonlethal methods (Directive 2.115).

- WS-Utah will conduct formal and informal consultation with the USFWS, in West Valley, Utah. A Biological and Conference Opinion for WS-Utah WDM activities in the State of Utah will be completed by the USFWS and incidental take, reasonable and prudent measures and terms and conditions will be followed by WS-Utah.

- WS-Utah will contact cooperating agencies to determine bald and golden eagle nest and winter roost locations in areas where PDM activities are proposed during annual work plan meetings. Annual meetings will also address other sensitive species for which the UDWR, BLM, USFWS and tribes are concerned (Directive 2.315).

- If bald or golden eagles are encountered during aerial PDM operations, the aircraft will leave the immediate vicinity as soon as possible (Directive 2.315).

- If wintering big game or wild horses are encountered during aerial PDM operations, the aircraft will take measures to avoid disturbance or leave the area (Directive 2.620).

- Only coyotes, wolves and red foxes or other species requested by other management agencies would ordinarily be taken by WS-Utah aerial PDM operations (Directive 2.620).

- M-44s will not be set in areas where ESA-listed Threatened, Endangered, Proposed, Candidate, or Experimental species populations might be adversely affected (Directive 2.415).

- Black bear and mountain lion damage management would be restricted to offending individuals, unless otherwise directed by the UDWR).

- The use of nonlethal methods, such as guard dogs and animals, scare devices and other methods, which may become available, would be encouraged when appropriate (Directive 2.201).

- WS-Utah will work with UDWR and the land management agency to minimize disturbance to sage-grouse during the spring lekking season (Directive 2.210).

3.5.2.3 Impacts on Special Management Areas (SMAs)

- PDM would follow guidelines as specified in Utah AWPs.
- Vehicle access would be limited only to existing roads existing roads, unless off-road travel is specifically allowed by the land managing agency and conforms to the LRMPs and RMPs.
- PDM would not be conducted without prior consultation with the land management agency.
- WS-Utah personnel collaborate with the public land management agencies to develop AWPs which identify areas or circumstances (e.g., a special use permit for a specific gathering or event on public lands) during which the use of certain methods will not be used in order to minimize conflicts with other uses of the site. 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 to discuss and resolve the situation.
- WS-Utah may also develop systems for consultation and coordination with tribes at the request of the tribe.
- PDM would be conducted only when and where a need exists.
- No aerial PDM will be conducted in any wilderness area unless specifically coordinated with the applicable USFS Regional Office or BLM State Office.
- No toxicants would be used in any wilderness or other SMA.
- No proactive (preventative) control would be conducted in any Wilderness Area.
- PDM in Wilderness Areas would be in accordance with Wilderness Policies and National MOUs and any provisions identified in AWPs.
- WS-Utah does not anticipate conducting PDM in National Parks. However, the potential exists that a request could come from the National Park Service, USFWS or UDWR for responding to a threat to human health and safety or for research purposes.

3.5.2.4 Humaneness and ethical perspectives

- Chemical immobilization and euthanasia procedures that do not cause pain or undue stress are used by certified personnel when practical (Directive 2.430).

- Research will continue to improve the selectivity and humaneness of PDM methods and tools (Directive 2.110).

- WS-Utah personnel will 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. In some situations, accepted chemical immobilization and euthanasia methods are used (Directive 2.505).

- Foothold traps and snares would be checked at intervals consistent with State of Utah regulations (Directive 2.450).

- Pan-tension devices would be used to reduce the incidence of nontarget animal capture in foothold traps and leg snares, unless such devices would preclude capturing target animals (Directive 2.450).

3.5.2.5 Cultural Impacts including impacts on Native American cultural uses, hunting, non-consumptive uses, and aesthetic impacts

- WS-Utah personnel develop AWPs in cooperation with BLM and USFS annually to discuss potential PDM activities and exchange information necessary to reduce conflict with other multiple uses on said lands. These plans include delineation of areas where certain methods may not be used during certain time periods when conflicts with recreation, wildlife viewing, hunting and other planned multiple use events may occur.

- WS will establish a system of regular consultation and communication with the Tribal governments of Utah, to inform the tribes of WS-Utah activities and to collaborate on mechanisms to minimize potential risks of adverse impacts on cultural sites, hunting and gathering by tribal members and other cultural values and activities of tribal members within the ceded territory, when needed.

- PDM activities will be conducted in accordance with and for the areas specified in BLM RMPs and USFS LRMPs.

- WS-Utah will consult with the Utah State Historic Preservation Office as necessary to determine if PDM is likely to affect historic properties or archeological sites.

3.5.2.6 Impacts on public and pet safety and the environment

- All pesticides used by WS-Utah are registered with the EPA and UDAF. WS-Utah employees will comply with each pesticide's directions and labeling, along with EPA and UDAF rules and regulations. Pesticides are stored in compliance with EPA and UDAF pesticide label requirements and in closed containers at APHIS-WS worksites. Storage sites are inspected annually by supervisors or managers (Directive 2.401).

- Pesticide use complies with EPA and UDAF rules and regulations administered by UDAF (Directive 2.401).

- EPA-approved label directions are followed by WS-Utah employees (Directive 2.401).

- WS-Utah inventories all pesticides and hazardous materials monthly and reports such inventory to the State Office (Directive 2.401).

- Unattended pesticides are locked in a secure and adequate location at all times to prevent theft or unauthorized use (Directive 2.401).

- WS-UDAF employees who use pesticides participate in continuing education programs to keep abreast of developments and to maintain their certification. Certification is also maintained through re-testing every three years (Directive 2.401).The APHIS-WS Decision Model is designed to identify the most appropriate PDM strategies and their impacts (Directive 2.201).

- WS-Utah employees that use pesticides are trained to use each specific material and are certified to use pesticides under EPA and state approved certification programs (Directive 2.401).

- M-44s are used by WS-Utah personnel who are trained and have State certification of category 9 regulatory pest control from UDAF to use sodium cyanide and the M-44 device within label restrictions. Predator damage management activities that involve the use of sodium cyanide and the M-44 device are conducted in accordance with both State and federal EPA regulations and label restrictions (2.415).

- Bilingual (English and Spanish) warning signs are posted on main roads and/or trails leading into any areas where foothold traps, snares or M-44s are being used. These signs would be removed at the end of the control project.

- The LPC is registered by the EPA and UDAF. WS-Utah personnel who use apply this pesticide are provided training in for use, recordkeeping, personal protective equipment, proper waste disposal, antidote and storage (Directive 2.420).

- All LPCs not in use are kept under lock and key at all times (Directive 2.420).

- Foothold traps and snares are placed so that captured animals will not be readily visible from any designated recreational road or trail shown on US Forest Transportation Maps or from federal, State or county roads (Directive 2.450).

- In addition to area warning signs, individual proximity warning signs would be placed within 25 feet of each M-44 device (Directive 2.415).

- No foothold traps, snares or M-44s would be allowed within ½ mile of any residence, community or developed recreational site, unless requested by the owner of a privately-owned property or an official from the appropriate land management agency (Directives 2.450 and 2.415).

- WS consultations with tribes and land management agencies will include information on areas which are heavily used by recreationists (e.g., commonly used trails) and tribal members exercising treaty rights and times of year when use is particularly heavy so that PDM activities in these areas may be planned to minimize safety risks (Directives 2.101 and 2.105).

- Public safety zones are delineated and defined in AWPs by BLM and USFS during annual AWP reviews. The public safety zone is ¼ mile, or other appropriate distance, around any residence or community, county, State or federal highway or developed recreation site (Directive 2.210).

- Predator Damage Management conducted on federal lands within the identified public safety zones will generally be limited to activity aimed at the protection of human health and safety. However, land management agencies could request PDM activities in the public safety zone for an identified need (Directive 2.210).

- WS-Utah personnel who use immobilization and euthanasia controlled substances are required to obtain a 16-hour training course and take a Distance Learning Module training course. Refresher training is required every three years. Registration and licensing are annual requirements (Directive 2.430).

- All aerial PDM operations and safety activities, including ATOC training and maintenance, are conducted in strict compliance with the Federal Aviation Regulations, Fish and Wildlife Act of 1956, applicable State and local laws and regulations, WS-Utah's Aviation Safety Plan, Aviation Communication Plan and Aviation Emergency Response Plan (Directive 2.620).

3.5.2.7 Cost effectiveness

- The cost effectiveness of different PDM methods and actions will be used to assist WS-Utah's planning and decision making. Consideration will be given to different values, such as selectivity and humaneness, impact on tribal members exercising treaty rights, values of wildlife to non-consumptive users, potential economic impacts of ecological services provided by target and nontarget species; as well as overall monetary costs within the constraints of the financial resources available.

3.5.2.8 Consultation and coordination

- WS-Utah will establish a mechanism of regular consultation and coordination with the federally recognized tribal governments within Utah to address concerns regarding potential impacts of WS-Utah activities on cultural resources, treaty rights, and other issues of importance to the tribes relative to PDM, at the tribe's request.

3.5.2.9 Indirect and cumulative impacts

- WS-Utah personnel consult with BLM, USFWS, USFS, UDWR, local tribes and other appropriate agencies regarding program impacts. Frequent contacts are made with BLM and USFS when conducting PDM on public lands administered by these agencies.

- WS-Utah regularly coordinates with UDWR, USFWS and affected tribes concerning the wildlife species being targeted and numbers taken.

- PDM activities are directed at taking action against individual problem animals or local populations to resolve depredation problems.

- WS-Utah take of predators is monitored. Total animal take is considered in relation to the estimated population numbers of key species. These data are used to assess cumulative effects so as to maintain the magnitude of harvest below the level that could impact the viability of a population.

3.6. ALTERNATIVES AND STRATEGIES NOT CONSIDERED IN DETAIL

3.6.1 Nonlethal Control Required Prior to Lethal Control

This alternative is incorporated into the present Alternative 1. The Alternative, as originally identified, requires livestock producers to use nonlethal practices prior to the implementation of lethal damage management. Nonlethal methods selected by producers could include livestock husbandry, habitat modification and animal behavior modification methods, or other nonlethal methods. However, no standard exists to determine producer diligence in applying these methods, nor are there any standards to determine how many nonlethal applications are necessary before the initiation of lethal damage management. Thus, only the presence or absence of nonlethal methods can be evaluated. An analysis of the WS-Utah cooperators grazing sheep showed that 100% of the producers were utilizing at least one nonlethal damage management method during FY16 (personal communication Commissioner of UDAF). WS-Utah continues to encourage Utah producers to use more than one type of nonlethal method. In addition, NASS (2015) found that at least 14 nonlethal methods were used among Utah producers to protect livestock. Some of the most common nonlethal methods used by Utah producers included fencing at 75.4%, shed lambing at 78.2 %, donkeys at 48%, and frequent checks at 56%, altered breeding season at 48%, change bedding at 54.5%, and guard dogs at 25%. Therefore, it was determined that an analysis of this alternative would be identical to the analysis of the current program for livestock protection. Consideration of wildlife needs would not be included with the producer implemented nonlethal methods, nor would WS-Utah base damage management strategies on the needs of designated wildlife for predator protection. The current Alternative 1 incorporates the nonlethal prior to lethal component, further refining WS-Utah lethal damage management.

3.6.2 No Federal WS-Utah Program

Under this alternative, there would be no federal PDM conducted by WS-Utah. However, under the Utah Agricultural and Wildlife Damage Prevention Act, and under the authority of UDAF and UDWR, the state of Utah would continue the PDM work that WS-Utah currently conducts. The current WS-Utah program is a combination of federal and state funds and employees, with only 11 employees in the WS-Utah workforce being federal employees that are working on projects related to this EA. Additionally 3 supervisors and 3 office support staff are federal employees, and could continue federal work unrelated to PDM in Utah. The remaining 17WS-Utah PDM workforce are already state employees who could continue the same work under a No Federal WS-Utah alternative. Therefore, a No Federal WS-Utah program would be very similar to the current program, and after a brief structural realignment of supervisory duties to UDAF and possible changes in employee classification, the effects of that program would be almost identical to the Current Program (Alternative 1).

3.6.3 No WS-Utah PDM on Federal Public Lands

WS-Utah access to lethal methods for PDM on federal public lands is determined by State regulations and the management plans and policies of the respective federal agency. In general, producers leasing grazing allotments, natural resource managers working to protect sensitive species and agency officials responding to threats to human safety associated with predators on federal lands have legal access to the same types of damage management methods as would be used by WS-Utah. Only three PDM methods are completely or partially restricted to use by WS-Utah, livestock protection collars, and M-44s. Livestock protection collars are not registered for use on open range and would not be used on federal lands. No M-44s have been used on any National Forest lands within the past 15 years. M-44 use on BLM land has limited use. WS-Utah personnel place M-44s only on properties identified in “Work Initiation Document for Wildlife Damage Management” (WS Forms 12A, 12B, and 12C signed by the property owner or manager, or as developed in work plans for work on public lands. M-44 use is specifically authorized through a signed written agreement or through provisions in work plans with cooperating agencies. M-44s may be used on Federal lands except in areas specifically designated for recreational use. M-44 non-use areas on public lands will be identified through interagency consultations at the WS-Utah State office or District office level; such non-use areas will include beaches, campgrounds and locations where seasonal use such as hunting occurs. Consultations are not needed for types of lands where M-44s will never be used. "Wildlife refuge areas" means officially designated Federal or State wildlife refuges or wildlife management areas that are identified as such by appropriate signs and maps.

WS-Utah will coordinate quarterly with the land management agency to determine where M-44s may or may not be used on public lands in certain areas. These quarterly contacts can be made through workplan meetings, telephone conversations, in person, or email. Within 30 days after each quarterly contact, WS-Utah needs to provide written documentation of the land management agency's determination of any identified set aside recreation areas (i.e. projected or current areas).

Quarterly contacts will also allow for addressing the use of M-44's and unscheduled events that were not planned or discussed during the annual workplan meetings. M-44s will not be placed within 0.5 mile of occupied residences except for those belonging to a cooperator who has requested the use of M-44s and has signed a Work Initiation Document. Within properties where its use is authorized, the M-44 device shall not be used in areas where exposure to the public and family and pets is probable per Use Restriction 8(2). WS will notify the owner or lessee occupying any residence at or near 0.5 mile perimeter of an M-44 device of their use in the area. Notification must be in a manner that ensures that the message was delivered and receipt acknowledged. A voicemail message or note on the door does not constitute notification for this purpose.

Documentation of the notification as defined above will be maintained by the applicator and filed with the state Wildlife Services office no later than 14 days after placement. Documentation must include: name of person notified, manner in which notified (telephone, in person, email with response, certified mail delivery receipt), date and time the notification took place. The USDA/APHIS/WS "M-44 Device for Local Predator Control" Fact Sheet can be provided as supplemental information when notifying persons in nearby areas.
The identity of the Cooperator and of the Cooperator's property, must not be shared directly with the notified individuals due to federal privacy protection rules, unless the Cooperator has authorized disclosure.

WS-Utah personnel should accurately identify property boundaries where M-44 devices are to be placed. If the property boundaries are not clearly posted, or the landowner or lessor is unable to accurately identify the property boundaries, WS-Utah personnel shall use electronic mapping or aerial imagery to identify: a) property boundaries to ensure devices are placed on the property covered by the agreement; and b) residences to ensure none are within 0.5 mile of the device and to further identify those at or near the 0.5 mile perimeter that require notification. Buildings that are obviously abandoned or not actively occupied are not residences for purposes of this interpretation.PDM can and is being conducted on federal lands by entities other than WS-Utah (Sections 1.2.3, and 2.6.1). For example, Utah DWR predator control program initiated with the "Mule Deer Protection Act" in 2012, private trappers and hunters as well as ranchers protecting their stock. With this new law, the UDWR implemented a coyote control program that uses members of the public to take coyotes in regions where high mule deer predation occurs. Participants in the coyote control program receive $50 dollars for each coyote that is removed from designated areas and is properly documented.

Utah Administrative Code Agriculture and Wildlife Damage Prevention Board 4-23-6 allows private citizens to apply for a permit to engage in airborne control of unprotected or predatory animals to protect land, water, wildlife, livestock, domesticated animals, human life or crops.

Permitted persons cannot conduct aerial PDM activities on BLM and USFS lands. The State law further explains that information about airborne control activities authorized by UDAF 4-23-6 will be reported and recorded each year as a condition of the permit. Many predatory species may be taken by the public or other agencies for PDM in the same manner as actions by the WS-Utah program (Section 4-23). Additionally, under state rule R657-33-23. Livestock and commercial crop depredation states that black bear and mountain lion may be lethally removed by livestock owners, their employees, agents and animal damage control personnel when same are molesting or attacking livestock and it shall not be necessary to obtain a permit from UDWR, but must be reported within 48 hours.

3.6.4 No Lethal PDM at Taxpayer Expense

During public involvement, some respondents felt that WDM was a government subsidy and should not be provided at the expense of the taxpayer or that it should be fee based. Programs like WS-Utah reflect policy decisions made by Congress or State legislatures directed at serving the public interest as defined through the legislative process and therefore funding for WS-Utah comes from a variety of sources. Additionally, WDM is an appropriate sphere of activity for government programs, since wildlife is publicly owned and management is a government responsibility (also see Section 1.4).

WS was established by Congress as the program responsible for providing WDM to the people of the United States (Act of March 2, 1931, as amended 46 Stat. 1486; 7 USC 426-426c). Federal, state and local officials have all decided that WS-Utah should be conducted by appropriating funds. Utah general funds, livestock producer funds, county funds, and UDWR funds are all applied to the program under Cooperative Agreements. The livestock producers in Utah contribute funds through annual predator control fees (UCA §§4-23-7). Cooperating counties and associations also contribute funds for PDM. UDWR and UDAF funds are also applied to the WS-Utah program under a Cooperative Agreement with WS-Utah, and funds are received from requesters for individual or special projects and used to provide services as requested.

Although WS-Utah does support ranching and farming operations, WS-Utah personnel also provide technical assistance to assist in developing effective WDM practices for anyone requesting such assistance. WS-Utah serves urban, suburban and industrial interests by reducing wildlife damage to private property, assisting with the protection of the health and safety, and helping to deter the spread of wildlife-borne diseases. As the requests for assistance change, the mix of services provided by the WS-Utah program will change accordingly. The protection of livestock will always be conducted by someone, a Federal WS-Utah program not only provides a service to the livestock producers but also protects property, natural resources and public health and safety, and conducts an environmentally and biologically sound program in the public interest (Schueler 1993).

This proposal is also problematical when considered in context of Executive Order 12898 Federal Actions to Address Environmental Justice. In this case, access to lethal PDM assistance from WS-Utah would be predicated on the ability of the producer to afford to pay expenses.

Low-income producers may not have the funds to pay for PDM assistance from WS-Utah, particularly if they have already recently paid to implement new nonlethal methods. It is the policy of the WS-Utah program to use available public funds for PDM to provide assistance to all producers equally regardless based on need for action, not ability to pay for services.

3.6.5 No IPDM Predator Control within any Designated Wilderness Areas or Wilderness Study Areas (WSAs)

The level of PDM activities that is expected to occur in designated wilderness areas, proposed wilderness areas, and WSAs is so minor that the effects of any of the alternatives that involve no WS-Utah lethal work would not likely be significantly different from the effects of a "No Control in Wilderness Areas" alternative. Some wilderness, proposed wilderness and WSAs in Utah have historic grazing allotments. Historically, WS-Utah has conducted PDM activities in WA or WSAs. The minor amount of PDM activities that is conducted by WS-Utah in wilderness, proposed wilderness, or WSAs conforms to legislative guidelines and MOUs between APHIS-WS and the responsible land management agencies.

WS-Utah and the land management agency meet annually to review work plans that delineate what, when, why, where, and how IPDM would be conducted. In wilderness areas, 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).

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 wilderness area specifically addresses restricted and allowable actions. Some USFS and BLM land management plans also address IPDM on lands under their jurisdiction, as appropriate (Appendix B).

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.

3.6.6 Livestock Protection Only

WS-Utah is a cooperatively-funded, service-oriented program that provides assistance to requesting public and private entities. WS-Utah responds to requests for assistance when valued resources are lost, damaged, or threatened by wildlife and the ESA to conserve T&E species. In addition, WS-Utah has the unique expertise to resolve many wildlife damage problems and WS-Utah mission is to assist each requester with the appropriate action. WS-Utah would be derelict, as a public agency, if we did not respond to the public's need (*i.e.*, property, natural resources, public health and safety protection) and help resolve a multitude of wildlife damage problems. As requested, WS-Utah cooperates with state and federal resource management agencies to effectively and efficiently reduce wildlife damage according to all applicable federal, state and local laws (WS Directive 2.210). Responses can be in the form of technical assistance or operational damage management.

3.6.7 Eradication and Suppression

An eradication and suppression alternative would direct all WS-Utah program efforts toward planned reduction or total elimination of native predatory species.

Eradication of coyotes is legal in Utah but not supported by WS-Utah, UDWR or UDAF. This alternative will not be considered by WS-Utah in detail because:

- WS-Utah opposes eradication of any native wildlife species.
- UDWR opposes eradication of any native Utah wildlife species.
- UDAF opposes eradication of any native Utah wildlife species.
- The eradication of a native species or local population would be extremely difficult if not impossible to accomplish, and cost prohibitive.
- Eradication is not acceptable to most members of the public.

Suppression would direct WS-Utah program efforts toward managed reduction of certain problem wildlife populations or groups. Considering large-scale population suppression as the basis of the WS-Utah program is not realistic, practical, or allowable under present WS policy. Typically, WS-Utah activities would be conducted on a small portion of the area inhabited by problem species.

In localized areas where damage can be attributed to predation by specific groups, UDWR has the authority to lengthen hunting seasons and increase hunter tag quotas; UDAF has the authority to control unprotected predators, such as coyotes. When many requests for PDM are generated from a localized area, WS-Utah after consultation with UDWR or UDAF, would consider suppression of the local population or groups of the offending species, if appropriate.

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

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

This alternative is not necessarily 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 human hunting is usually conducted in the fall and winter, when damage often occurs in the spring and early summer; age and sex of animals targeted by hunters is typically different than those targeted by carnivores; and roads and other infrastructure often important for effective human hunting is not needed for hunting by carnivores (Ray et al. 2005). In addition, regulated hunting and trapping is often not allowed in urban or suburban areas because of safety concerns and local ordinances (Timm and Baker 2007). However, WS-Utah may certainly recommend to UDWR that a hunting or trapping season and an increase in regulated harvests may be helpful in reducing depredation in certain areas, if appropriate. Since this alternative is not within the authority of APHIS-WS to implement, it will not be considered in detail.

3.6.9 Live-Trap and Relocate 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-Utah would be relocated. In accordance with state law, relocation of bears and mountain lions must be approved by the UDWR under specific circumstances. Therefore, the relocation of bears and mountain lions by WS-Utah would only occur as directed by the UDWR and/or as authorized by state law.

Relocating problem bears or mountain lions, 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 relocated animal could return to its original trapping site. UDWR generally does not authorize the relocation of problem predators because of the high risk of moving the problem along with the problem animal. UDWR policy is to euthanize all captured coyotes, red fox, and raccoons and to never relocate problem animals, because of the healthy size of the populations statewide and the high risk of moving the problem along with the animal. Many smaller predators causing conflict are relatively abundant, such as coyotes, and skunks or are not native, such as feral cats and dogs. These UDWR policies avoid causing damage problems in the receiving site, reduce the risk that the animal will return to its original home range, and avoid potentially causing the death of the animal due to occupied territories or unfamiliarity with the new location.

However, WS-Utah could be requested and authorized by the UDWR to relocate individual problem bears or mountain lions, as a component of any alternative that includes an active WS-Utah program.

Relocation 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.

Therefore, this alternative is not considered in detail.

3.6.10 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.

3.6.11 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-Utah 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.

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

APHIS-WS does not have authority to require ranchers where and how ranchers graze or their livestock on private or federal land. However, WS-Utah may make reasonable recommendations on animal husbandry methods to reduce 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-Utah 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-Utah 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. Use of herders (Parks and Messmer 2016) represents a substantial financial obligation and may not be cost effective for producers with smaller herds/flocks. 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. Instead of mandating a specific set of management alternatives for all producers, the APHIS-WS Decision Model and IPDM process would be used by WS-Utah..

3.6.13 All Losses Confirmed by an Independent Entity (Not WS-Utah)

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

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

3.6.14 Livestock Producers Pay 100% of WS-Utah 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 nonlethal methods.

Under all alternatives in which WS-Utah provides lethal and/or nonlethal assistance, preference is already given to nonlethal methods in accordance with WS Directive 2.101. In many instances, WS-Utah is contacted after entities have unsuccessfully attempted to resolve their damage or threats on their own with nonlethal 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-Utah already provides technical support to all requesters and operational support (Alternative 1), including lethal assistance to some degree under all alternatives as determined appropriate.

Therefore, this alternative is contrary to agency policy and will not be considered in detail.

3.6.15 WS-Utah Contracts PDM Activities to the Commercial Sector or Defers All PDM Activities to UDWR

This alternative requires WS-Utah to award and oversee contracts for PDM activities to the commercial/private sector; WS-Utah would not conduct any technical or direct lethal or nonlethal assistance. All legally authorized methods would also be authorized in such contracts. WS-Utah would retain contracting responsibilities, provide oversight to ensure that PDM is implemented according to the statement of work, and document target and nontarget take as reported by the contractor. As the authorized federal agency, WS-Utah would continue to be responsible for environmental and NEPA compliance. Private contractors would not be contracted to use M-44s.

UDWR trains and certifies commercial companies and provides their contact information and qualifications on its website. However, none of these companies have advertised such expertise or equipment for larger predators such as bears and mountain lions. UDWR is often the first to be requested and to respond to damage caused by bears and mountain lions, and can either do the work itself, hire commercial companies, enter into an agreement with WS-Utah, and/or train and certify volunteers with pursuit dogs. Any PDM work not conducted or authorized by WS-Utah or by another federal agency would not require compliance with NEPA.

WS-Utah does not contract its authorized activities to other entities, including commercial entities. UDWR and its agents may already be hired directly by requesters to conduct PDM activities. WS-Utah would not assume any responsibility or liability for actions conducted by any other entity.

Therefore, this alternative will not be considered in detail.

3.6.16 Provide Compensation for Predator Losses

This option is not currently available to WS-Utah because APHIS-WS is directed by Congress to protect American agricultural, natural resources, property, and safeguard public health and safety (Act of March 2, 1931, as amended). Analysis of this issue shows that it has many drawbacks:

- It would require larger expenditures of money and workforce to investigate and validate all losses to determine and administer appropriate compensation.
- Compensation would most likely be below full market value.
- It is difficult to make timely responses to all requests to assess and confirm losses, and many losses could not be verified.
- Compensation would give little incentive to resource owners to limit predation through improved animal husbandry practices and other management strategies.
- Not all ranchers would rely completely on a compensation program and unregulated lethal control of predators would most likely continue as permitted by state law.
- Congress has not appropriated funds to compensate for predation or other wildlife damage to agricultural products.

UDWR does pay compensation for verified mountain lion and black bear damage, as directed by statute and appropriation language. WS-Utah involvement in that program is to verify losses and provide certification to the UDWR. As of this writing, the compensation fund is capped at $180,000/year and losses are prorated based on total loss numbers and values. APHIS-WS has no legal authority or jurisdiction to provide for financial compensation for losses. None of the predators included in this EA are covered by compensation allowances under the Agricultural Act of 2014 (aka the 2014 Farm Bill). Difficulties with compensation programs are discussed in Bulte and Rondeau (2005) in Section 1.14.7.2. This issue is better addressed through the political process at the county or state level.

3.6.17 Encourage Bounties, Trapping, Hunting, and Calling to Reduce Predation (*i.e.*, recreational harvest)

It has been suggested WS-Utah encourage trapping, hunting, calling and bounties to reduce predation. Currently, there are no season or license restrictions on the public with regards to the taking of coyotes or red fox in Utah. The UDWR administers the UWB policies for the taking of mountain lions and bears. Current policies of the UWB allow for the UDWR to direct recreational hunters into areas of depredation to remove depredating mountain lions or bears.

The jurisdiction for managing most resident wildlife rests with the UDWR (UCA §§23-13-2) who has the authority to request other agencies' assistance in achieving management objectives (UCA, Title 4 Chapter 23). Currently, UDWR manages mountain lions and black bears as protected wildlife under a strategic plan. If deemed necessary, the UDWR has the option and authority to reduce or increase restrictions on hunting to provide for more or less harvest opportunities for sportsmen and women. Likewise, the UDWR can direct or request WS-UT to conduct additional PDM activities at their discretion. The current strategic plans for both species and joint UWB and AWDPB policies support the current system of predation management. Red fox are managed as unprotected furbearers with no license or bag limit restrictions. Coyotes are managed as Predatory Animals under the jurisdiction of the UDAF. Currently there is no closed season for coyotes in Utah. Most private trappers and hunters are not able to provide year-round site-specific coyote damage reduction. That option, however, remains open to entities experiencing damage or the threat of damage.

Payment of funds for killing predators (bounties) to reduce damage or economic loss is not generally supported by the AWDPB (WS-Utah Annual Management Plan 2016) because:

- They are not generally effective in reducing damage,
- Circumstances surrounding take of animals are largely unregulated,
- No process exists to prohibit taking animals from outside the damage management area for compensation,
- WS-Utah does not have the authority to establish a bounty program

In 2015, the UDWR transferred $150,000 of discretionary funds to the UDAF to support county sponsored predator programs on a matching fund basis with local governments. The AWDPB has directed the UDAF to limit these programs to coyote programs.

Decline in several mule deer units in Utah prompted the Utah legislature to pass the Mule Deer Protection Act in early 2012. This new law requires the UDWR to reduce coyote populations to help protect declining mule deer. The state has increased funds to the WS-Utah aerial program to increase effort in the predator management plan in specific deer herd units. In addition with this new law, the UDWR implemented a coyote control program separate from WS-Utah that uses members of the public to take coyotes in regions where high mule deer predation occurs. Participants in the coyote control program receive $50 dollars for each coyote that is removed from designated areas and is properly documented. Participants must register with the state, and complete an online training course. Reimbursement only occurs for coyotes taken form October 20th to July 1st. Animals removed from the incentives program will be analyzed as part of the cumulative impacts sections.

3.6.18 Modify Habitats to Reduce Predation

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

3.6.19 Use of Reproductive Inhibitors or Sterilization Instead of Lethal PDM

Contraceptive measures for mammals can be grouped into four categories: surgical sterilization, oral contraception, hormone implantation, and immunocontraception (*i.e.,* the use of contraceptive vaccines). These techniques would require that each animal receive either single, multiple, or possibly daily treatment to successfully prevent conception. In addition, the use of oral contraception, hormone implantation, or immunocontraception would be subject to approval by Federal and state regulatory agencies.

These methods were not analyzed in detail in the EA because: (1) surgical sterilization would require that each animal be captured and sterilization conducted by licensed veterinarians and would therefore be extremely labor intensive and expensive; and (2) there are not currently any federally or state approved chemosterilants available for operational use in PDM.

Potential environmental concerns with chemical sterilization would still need to be addressed, including safety of genetically engineered vaccines to humans and other wildlife. At this time, chemical sterilization is controversial among wildlife biologists and many others. In any event, no contraceptive agents or methods are currently registered and are thus not legal for use or practical for use on predators in most areas. Should chemical sterilants become registered in the future, WS-Utah could consider them among the methods to be used in their program. Any additional NEPA analyses deemed necessary at that time would be conducted. The use of contraceptives is not realistic at this point, since effective and legal methods of delivering contraceptives to predators are not yet available for operational use.

Surgical sterilization for predation management is still under research by the NWRC. If a field trial were proposed in Utah involving surgical sterilization, such work would be conducted under research protocol, close monitoring to help determine results and to identify adverse effects.

Contraceptive measures for mammals can be grouped into four categories: surgical sterilization; oral contraception; hormone implantation; and immunocontraception (the use of contraceptive vaccines). These techniques would require that each individual animal receive either single, multiple or possibly daily treatment to successfully prevent conception. The use of oral contraception, hormone implantation or immunocontraception would be subject to approval by federal and State regulatory agencies.

These methods were not analyzed in detail in the EA because: (1) surgical sterilization would require that each animal be captured and sterilization conducted by licensed veterinarians and would therefore be extremely labor intensive and expensive; and (2) there are not currently any federally or State approved chemosterilants available for operational use in predator control.

Bromley and Gese (2001*a*, 2001*b*) conducted studies to determine if surgically sterilized coyotes would maintain territorially and pair bond behavior characteristics of intact coyotes and if predation rates by sterilized coyote pairs would decrease. Their results suggested that behaviorally, sterile coyote pairs appeared to be no different than intact pairs except for predation rates on lambs. Reproductively intact coyote packs were six times more likely to prey on sheep than were sterilized packs (Bromley and Gese 2001*b*). They believed this occurred because sterile packs did not have to provision pups and food demands were lower. Therefore, sterilization could be an effective method to reduce lamb predation if enough alpha (breeding) pairs could be captured and sterilized. During Bromley and Gese's (2001*a*, 2001*b*) studies: (1) they captured as many coyotes as possible from all packs on their study area; (2) 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; and (3) they concluded 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 2001*b*).

As alternative methods of delivering sterilants are developed, sterilization may prove to be a more practical tool in some circumstances (DeLiberto et al. 1998). Reduction of local populations could conceivably be achieved through natural mortality combined with reduced fecundity. No predators would be killed directly with this method, however, and treated predators could continue to cause damage. Populations of dispersing predators would probably be unaffected.

Potential environmental concerns associated with the use of chemical sterilization would still need to be addressed, including safety of genetically engineered vaccines to humans and other wildlife. At this time, chemical sterilization is controversial among wildlife biologists and many others. In any event, no contraceptive agents or methods are currently registered and are thus not legal for use or practical for use on predators in most areas. Should any become registered in the future, WS-Utah could consider them among the methods to be used in their program. Any additional NEPA analyses deemed necessary at that time would be conducted. The use of contraceptives is not realistic at this point, since effective and legal methods of delivering contraceptives to predators are not yet available for operational use.

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

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

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

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

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

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

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

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

Therefore, this alternative is not considered in detail.

3.6.21 Use Only Non-lead Ammunition

APHIS-WS' use of lead ammunition is a small fraction of total lead contamination from many sources. WS-Utah 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 Utah and elsewhere, in the appropriate calibers. It is also more expensive at this point.

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

WS-Utah 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.

3.6.22 Use Bear Repellents

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

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

Chapter 4 provides information needed for making informed decisions on the PDM objectives outlined in Chapter 1, and the issues and affected environment discussed in Chapter 2. The chapter consists of: 1) analyses of how each alternative meets the objectives, 2) a consistency assessment of the alternatives with existing land management plans, and 3) analyses of the environmental consequences of each alternative.

4.1.1 Environmental Consequences

The environmental consequences of each alternative are compared with the environmental baseline (no action alternative or Alternative 1) to determine if the real or potential impacts are greater, lesser or the same. Cumulative and unavoidable impacts, and direct and indirect effects are discussed in relation to the issues for each of the alternatives and the potentially affected species in this Chapter, as appropriate.

- *Direct effects* are caused by the proposed action and occur at the same time and place.
- *Indirect effects* are caused by the proposed action and are later in time or further removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate and related effects on air and water and other natural systems, including ecosystems.

"Results from the incremental impact of the action when added to other past, present, and reasonably future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 CFR §1508.7)

The consideration of past actions may be considered in a cumulative impact analysis as the baseline to which the impact associated with the proposed action or alternative is compared and contrasted. It may also provide a context of the trends over time related to direct or indirect effects associated with the proposed action or alternatives or may illuminate or predict future direct or indirect effects of the proposed action based on past experience with similar types of proposed actions (CEQ 2005).

WS-Utah PDM activities have been evaluated for their impacts on several natural environmental factors. The alternatives are compared with the environmental consequences of the proposed action. However there are some natural resources that are not discussed in this EA because the impacts on them are considered negligible.

4.1.2 Non-significant Impacts

The actions discussed in this EA do not involve major ground disturbance, construction, or habitat alteration. They would not cause changes in the flow, quantity, or storage of water resources. All chemicals used for PDM are used, stored, and disposed of in accordance with EPA and State requirements for the protection of the environment. Consequently, the following resources within Utah are not expected to be significantly impacted by any of the alternatives analyzed: soils; geology; minerals; water quality and quantity; floodplains; wetlands; other aquatic resources; visual resources; air quality; prime and unique farmlands; timber; and range. These resources will not be analyzed further.

4.1.3 Irreversible and Irretrievable Commitments of Resources

No irreversible or irretrievable commitments of resources are expected, other than the minor use of fuels for motor vehicles, other gas powered equipment and similar materials. These will not be discussed further.

4.1.4 Other Environmental Resources

All WS-Utah actions would meet the requirements of applicable federal laws, regulations and Executive Orders for the protection of the environment, including the Clean Air Act and Executive Order 13514. WS-Utah activities are evaluated for their impact on the human environment and compliance with Executive Order 12898 to ensure Environmental Justice. WS-Utah personnel use WDM methods as selectively and environmentally conscientiously as possible. All chemicals used by WS-Utah are regulated by the EPA through FIFRA, ISDA, by MOUs with federal land management agencies and by WS Directives. The WS-Utah operational program properly disposes of any excess solid or hazardous waste. 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. Similarly, because WS makes it a high priority to identify and assess environmental health and safety risks, WS-Utah has considered the impacts that alternatives analyzed in this EA might have on children as per Executive Order 13045. All WS-Utah PDM is conducted using only legally available and approved damage management methods where it is highly unlikely that children would be adversely affected.

Activities described under the proposed action do not cause major ground disturbance and are not undertakings as defined by the NHPA. In most cases, PDM has little potential to cause adverse effects to sensitive cultural resources because construction and earth moving activities are not conducted.

4.1.5 WS-Utah Aerial PDM

Aerial PDM crews fly in specific areas for relatively brief periods of time before moving on to other areas where WS-Utah services have been requested. Therefore, the potential for adverse impacts on wildlife and recreationists are low. Because of the large expanses of area involved, it is rare for even WS-Utah ground crew personnel to actually observe animals being shot by aerial shooting operations. Thus, the chance that recreationists might be disturbed by observing such activity is exceedingly low.

APHIS-WS intensely evaluated aerial shooting impacts in Utah by conducting a comprehensive review of the literature, and taking a hard look at site specific and cumulative impacts. The following analysis is for WS-Utah predator damage management program in Utah from FY11 through FY 15, regardless of land status.

Table 4-0 Time and Acres Flown by WS-Utah in FY11 through FY15

Fiscal Year	Fixed Wing Hours	Fixed Wing Acres*	Helicopter Hours	Helicopter Acres	Total Acres Flown**
11	673.7	8,237,390	494.1	8,319,703	16,557,093
12	1,057.1	11,628,206	407.3	4,985,635	16,613,841
13	884.4	10,414,932	518.4	6,776,665	17,191,597
14	756.8	13,700,990	489.6	2,385,274	16,086,264
15	837.7	2,770,417	596.6	12,222,012	14,992,429

*Represents total acreage on agreements flown. The actual acreage flown is less than the total, as terrain and vegetation do not permit flying each and every acre.
**Acreages flown do not total because some agreements were flown by both fixed wing and helicopter.

Cumulative impacts of low level aerial disturbances include military and commercial overflights in addition to WS-Utah activities. Several low-level military operation areas (MOA's) exist within the state. These include Lucin A, Lucin B, Gandy, Sevier A,B,C, and D, and the Desert MOA WS-Utah conducts very few flights in these areas due to the difficulty of scheduling the MOA's in general. All flights are conducted in coordination with the local USAF operations control. WS-Flights in these areas are of short duration, and infrequent.

Low –level commercial flights in Utah include site seeing flights near national parks, and commercial service to Cedar City and St. George, Utah. WS-Utah conducts no activities in these areas because of potential conflict with commercial air traffic. Because there are no scheduled low level activities in commercial areas where WS-Utah conducts aerial shooting and the impact of WS-Utah activities are of a low magnitude, APHIS-WS analysis determined that there are no cumulative impacts from WS-Utah aerial shooting activities.

Aerial shooting is an important component of WS-Utah integrated predator damage management program in Utah. For this analysis FY13 will be used to evaluate impact as it represents the time frame with the largest number of acres flown and the greatest potential for impacts. WS-Utah conducted aerial shooting on less than 29% of the state in FY 13. The intensity of aerial shooting in FY 13 averaged 3 minutes per square mile for the entire year. However, in some cases more time may be spent in certain areas, and thus less time is spent in other areas. The total amount of time spent aerial shooting depends on the severity of losses and the weather, with aerial operations restricted to Visual Flight Rules and impractical operating condition in high winds, or at times when predators are not visible. WS-Utah predator damage management activities are only conducted on those areas where the landowner, lessee or land management agency has provided approval.

Aircraft play an important role in the management of various wildlife species. Resource management agencies rely on low flying aircraft to monitor the population status of many types of animals including large mammals (Lancia et al. 2000), birds of prey (Fuller and Mosher 1987), waterfowl (Bellrose 1976), and colonial waterbirds (Speich 1986). Low-level flights are also required when aircraft are used to track animal movements by radio telemetry (Gilmer et al. 1981, Samuel and Fuller 1994).

A number of studies have looked at responses of various wildlife species to aircraft overflights. USDI (1995) reviewed the effects of aircraft overflights on wildlife and suggests that adverse impacts could occur to certain species. However, Pepper et al. (2003) reviewed a number of studies involving wildlife and aircraft noise and stated" the two most important elements of noise exposure in wildlife are the proximity to the airport and the frequency of overflights." Therefore, the more serious potential adverse effects occur when overflights are chronic (*i.e.,* they occur daily or more often over long periods of time). Chronic exposure situations generally involve areas near commercial airports and military flight training facilities. WS-Utah aerial shooting operations rarely occur in the same areas daily and, as previously noted, little time is actually spent flying over those particular areas.

Examples of species or species groups that have been studied with regard to the issue of aircraft-generated disturbance and WS-Utah determination of potential impacts from aerial shooting overflights are as follows:

Birds

Waterbirds and Waterfowl. Low level overflights of 2-3 minutes in duration by a fixed-wing airplane and a helicopter produced no "drastic" disturbance of tree-nesting colonial waterbirds, and in 90% of the observations, individual birds either showed no reaction or merely looked up (Kushlan 1979). Belanger and Bedard (1989, 1990) observed responses of greater snow geese (*Chen caerulescens atlantica*) to man-induced disturbance on a sanctuary area and estimated the energetic cost of such disturbance and concluded that overflights of sanctuary areas should be strictly regulated to avoid adverse impacts. Conomy et al. (1998) quantified behavioral responses of wintering American black ducks (*Anas rubripes*), American wigeon (*A. americana*), gadwall (*A. strepera*), and American green-winged teal (*A. crecca carolinensis*) exposed to low-level military aircraft 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.

Most WS-Utah aerial shooting activities are not conducted over wetland habitats, federal refuges, or State Waterfowl Management Areas at this time. If requested, these flights may be conducted for the protection of nesting birds from predators and would result in increased waterfowl production. No WS-Utah management would be conducted without consent from the managing agency. Thus, there is little to no potential for any adverse effects on these types of birds. In September 2016, WS-Utah cooperated by request with the UDWR using aerial shooting to remove feral swine at a state WMA in northern Utah.

Raptors. The ANG (1997a) 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, USFS 1992, Fraser et al. 1985, Lamp 1989). A study conducted on the impacts of overflights to bald eagles (*Haliaeetus leucocephalus*) suggests that the eagles were not sensitive to this type of disturbance (Fraser et al. 1985). Evidence also suggests that golden eagles (*Aquila chrysaetos*) are not highly sensitive to noise or other aircraft disturbances (Ellis 1981, Holthuijzen et al. 1990). Awbrey and Bowles (1990) found that eagles were particularly resistant to being flushed from their nests. Therefore, there is considerable evidence that eagles would not be adversely affected by WS-Utah aerial shooting overflights.

Mexican spotted owls (*Strix occidentalis lucida*) did not flush when chain saws and helicopters were greater than 110 yards away (Delaney et al. 1999). When they did flush, owls returned to their predisturbance behavior 10-15 minutes following the event and researchers observed no differences in nest or nestling success (Delaney et al. 1999), which indicates that aircraft flights would not result in adverse effects on owl reproduction or survival.

Andersen et al. (1989) conducted low-level helicopter overflights directly at 35 red-tailed hawk (*Buteo jamaicensis*) nests and concluded their observations supported the hypothesis that red-tailed hawks habituate to low level flights during the nesting period; results showed similar nesting success between hawks subjected to overflights and those that were not. White and Thurow (1985) did not evaluate the effects of aircraft overflights, but 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 Thurow 1985). 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 (*Aquila chrysaetos*) 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.

Passerines. Reproductive losses have been reported in one study of small territorial passerines ("perching" birds that include sparrows, 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 species. The research review indicated passerine birds cannot be driven any great distance from a favored food source by a non-specific disturbance, such as military aircraft noise, which indicates the much quieter noise of WS-Utah small planes would have even less effect. Passerines avoid intermittent or unpredictable sources of disturbance more than predictable ones, but return rapidly to feed or roost once the disturbance ceases (Gladwin et al. 1988, USFS 1992). These studies and reviews indicate there is little or no potential for WS-Utah overflights to cause adverse effects on passerine bird species.

Sage-grouse. Sage-grouse (*Centrocercus urophasianus*) leks found throughout central, southern, and northern Utah (*i.e.*, strutting grounds used by males during the breeding season). State wildlife agencies routinely use aircraft to locate sage-grouse leks and WS-Utah has been requested by the UDWR and UDAF to conduct searches for leks and to conduct predator damage management in nesting areas[21]. Therefore, impacts are probably minor or none existent when overflights occur on an infrequent basis and care is taken to avoid leks. The USFWS reviewed available scientific and other information on threats to sage-grouse and did not identify aerial overflights as a concern, although they did identify other types of activities such as off-road vehicles and recreation as potentially having disturbance effects on breeding (USFWS 2005).

Mammals

Mule Deer. Krausman et al. (1986) reported that only 3 of 70 observed responses of mule deer (*Odocoileus hemionus*) to small fixed-wing aircraft overflights at 150 to 500 feet AGL resulted in the deer changing habitats. The authors believed that the deer may have been accustomed to overflights because the study area was near an interstate highway which was followed frequently by aircraft. Krausman et al. (2004) also reported that mule deer do not hear noise from military aircraft as well as humans, which potentially indicates why they appear not to be disturbed as much as previously thought. Therefore, available scientific evidence indicates overflights do not cause any adverse effects on mule deer populations. However, to the extent that localized coyote removal reduces predation on deer fawns, benefits to such species would outweigh potential adverse impacts from aerial shooting, similar to the way it reduces lamb losses on lambing ranges (Wagner and Conover 1999). If so, then aerial shooting of coyotes may have a net benefit to mule deer populations.

Bighorn Sheep. Krausman and Hervert (1983) reported that, of 32 observations of the response of mountain sheep to low-level flights by small fixed-wing aircraft, 60% resulted in no disturbance, 81% in no or "slight" disturbance, and 19% in "great" disturbance. The authors concluded that flights less than 150 feet AGL can cause mountain sheep to leave an area. WS-Utah does not conduct aerial shooting in typical higher elevation mountain sheep habitat. If wild sheep are observed, the pilot avoids pursuit or harassment, therefore WS-Utah aerial shooting will have minimal or no impact to mountain sheep.

Bison. Fancy (1982) reported that only two of 59 bison (*Bison bison*) groups showed any visible reaction to small fixed-winged aircraft flying at 200-500 feet above ground. The study suggests that bison are relatively tolerant of aircraft overflights.

Consequences of Aerial Shooting Accidents

Aerial shooting, like any other flying, may result in an accident. WS-Utah pilots and crew members are trained and experienced to recognize the circumstances which lead to accidents and have thousands of hours of flight time. The national WS Aviation Program has increased its

21 Removal of coyotes may benefit sage-grouse populations, as coyotes were identified as one of predators of grouse (Stinson et al. 2004).

emphasis on safety, including funding for additional training, the establishment of a WS Flight Training Center and annual recurring training for all pilots. Still, accidents may occur and the environmental consequences should be evaluated. WS-Utah has had one non-fatal aviation accident since 2011. The helicopter was a total loss. Additional information on the impact of the Aerial PDM program on public safety are discussed in section 4.6.4 of the EA.

USDA (2005) conducted a thorough evaluation and review of literature to conclude that WS-Utah aerial overflights, when combined cumulatively with other types of overflights such as military training, do not have the potential for significant adverse effects on the human environment either on a statewide or local level.

4.2 ISSUES ANALYZED IN DETAIL

The environmental consequences of the four alternatives are discussed below with emphasis on the issues described in Chapter 2. Those issues are:

- Effects of WS-Utah PDM on Target Species Populations
- Effects of the WS-Utah Program on Sensitive and Nontarget Species
- Effects of WS-Utah PDM Program Humaneness and Ethics.
- Effects of WS-Utah PDM on Public and Pet Safety

The comparison of alternatives that will be used to make a selection of the most appropriate alternative for WS-Utah under the current program are the same as those that have been used in recent years by WS-Utah. The PDM methods used in Utah to meet the purpose and the need for the proposed action as identified in Chapter 1 are also included.

Scale of Analysis Area

The scope of analysis for the proposed PDM activities is limited to the State of Utah because this is scale at which the majority of the regulatory, funding and wildlife management activities involving species addressed in this EA occur. Specifically, UDWR is the primary management authority for almost all wildlife species addressed in this EA except species federally-listed under the ESA, MBTA and Bald and Golden Eagle Protection Act. State-level management of resident wildlife is the norm across the country and is sufficient for most species with relatively limited movements, and we have chosen a similar scale for the impact analysis. However, for some species, the analysis of environmental impacts in this section may be conducted at a larger scale. For example, impacts on highly mobile species, such as migratory birds, are also considered at the regional scale. Similarly, impact on T&E species are discussed in context of overall USFWS management plans for the recovery of the species. Although the specific location where PDM occurs cannot be consistently predicted, local consequences of management actions are also addressed where applicable.

Significance Criteria

The CEQ regulations on implementation of the NEPA (40 CFR 1500-1508) describe the elements that determine whether or not an impact is "significant." Significance is dependent upon the context and intensity of the impact. The following factors will be used to evaluate the significance of impacts in this EA as they relate to the context and intensity of biological and other ecological effects. Social and economic impacts will be evaluated similarly to the extent applicable.

- **Magnitude of the Impact.** Magnitude relates to the size, number or relative amount of the impact. It is a measure of intensity. Magnitude as it relates to biological impacts is a measure of the number of individual animals or species removed in relation to their abundance. Magnitude may be determined either quantitatively or qualitatively. Quantitative analyses are preferred when possible, however, some issues do not lend themselves to quantitative analysis (e.g., some sociological issues) or quantitative data may not be available. In these instances, qualitative analyses incorporating information such as population trends, modeling and available studies and other publications (e.g., for review of most sociological issues) may be used.
- **Duration and Frequency of the Impact.** The duration and frequency may be temporary, seasonal, or year round. Duration and frequency of impact is a measure of intensity.
- **Likelihood of the Impact.** The likelihood of an impact is a measure of its intensity by estimating the possibility that an activity or impact may occur.
- **Geographic Extent**. The consideration of the geographic extent of an effect may be site specific, within a given management area, at the State/territory/tribal land area, regional and/or national land area. Geographic extent may also consider the range and movement patterns of animal species. The geographic extent of an effect is a contextual consideration.
- **Legal Status.** The legal status of an affected resource is a contextual consideration. Legal status may range from fully protected by federal law, such as an endangered species, to non-protected by law, as is the case for coyotes, fox, skunks and raccoons in Utah.
- **Conformance with Statutes, Regulations and Policies.** Statues, regulations and policies provide contextual information in the analysis. Compliance with applicable statutes, regulations and policies can also serve as mitigation to ensure that certain types of adverse impacts on the environment do not occur.

4.3 EFFECTS OF WS-UTAH PDM ON TARGET SPECIES POPULATIONS

The species evaluated in this chapter were selected for analysis because they are taken by WS-Utah in response to livestock and poultry predation, property damage, requests from wildlife management agencies to protect specific wildlife, and public health and safety threats.

Estimating wildlife densities is not precise and often dynamic, and professional judgment is required to account for unknowns and variables, such as the ability of habitats to support populations and recruitment. Therefore, assessments are based on conservative population estimates rather than higher population estimates to better insure that no adverse wildlife population effects occur.

4.3.1 Alternative 1 – Continue the Current Utah Adaptive Integrated PDM Program (No Action /Proposed Alternative)

4.3.1.1 Coyote Population Information

To discuss the effects of various environmental constraints and external factors on coyote populations and density, understanding the basic mechanisms that play a role in the coyote's response to constraints and actions is essential. The coyotes' unique resilience, its ability to adapt, and its perseverance under adverse conditions are commonly recognized among biologists and rangeland managers.

Determinations of absolute densities for coyote populations are frequently limited to educated guesses (Knowlton 1972). Coyotes are highly mobile animals with home ranges (territory) and population densities that vary depending on the season/time of year, food abundance, habitat, and sex and age of the animal (Pyrah 1984, Althoff 1978, Todd and Keith 1976). The literature on coyote spatial organization is confusing (Windberg and Knowlton 1988, Messier and Barrette 1982). Coyote densities have ranged from a low of 0.2/mi^2 when populations are low (prewhelping) to a high of 3.55/mi^2 when populations are high (postwhelping) (USDI 1979, Knowlton 1972). Coyote home ranges may vary from 2.0 mi^2 to 21.3 mi^2 (Andelt and Gipson 1979, Gese et al. 1988). Ozoga and Harger (1966), Edwards (1975), and Danner (1976) however, observed a wide overlap between coyote home range and did not consider coyotes territorial. In addition, the presence of unusual food sources and nonbreeding helpers at the den can influence coyote densities, and complicate any effort to estimate abundance (Danner and Smith 1980, Roy and Dorrance 1985).

Each occupied coyote territory may have several nonbreeding helpers at the den during whelping (Allen, et al. 1987, Bekoff and Wells 1982). Therefore, each defended coyote territory may have more than just a pair of coyotes. Messier and Barrette (1982) reported that during November through April, 35% of the coyotes were in groups of three to five animals and Gese et al. (1988) reported that coyote groups of 2, 3, 4, and 5 individuals comprised 40%, 37%, 10% and 6% of the resident population, respectively. 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 artificial reductions have occurred. Several studies (Connolly et al. 1976, Gese and Grothe 1995, Conner 1995, Shivik 1995, Sacks 1996, Shivik et al. 1996, Gese 1999) investigated the predatory behavior of coyotes and determined that the more dominant (alpha) animals (adult breeding pairs) were the ones that initiated and killed most of the prey items. Concerns that coyote removal activities might just exacerbate predation on livestock appear to be unfounded since the removal of local territorial (dominant, breeding adult) coyotes actually removes the individuals that are most likely to kill livestock and generally results in the immigration of subdominant coyotes that are less likely to prey on livestock.

The WS-Utah PDM program does not modify habitat and thus has no direct impact on connectivity of populations. However, connectivity has been identified as important for population viability and genetic diversity (Frankham 1995). Coyotes have a demonstrated ability to disperse long distances across varied terrain and should be considered as one meta-population.

Localized coyote populations could be affected by the current PDM program. Some speculate that wolves suppressed coyote densities and Schmidt (1986) reported many citations where the removal of dominant wolves in the early years of this century led to increases in coyote abundances. Schmidt (1986) further suggests that coyote distribution has expanded into all areas north of Panama.

Estimating the state-wide coyote population requires extrapolation of data from many sources. Coyote population studies suggest densities between 0.2 and 1.5 coyotes/mi^2 (USDI 1979:70). Connolly (Unpubl. Rprt. 1994) estimated coyote populations for the West Desert Eco-region of the BLM's Fillmore Field Office. Based upon published reports, field personnel input and past surveys, the autumn coyote population was estimated to be stable at about one coyote/mi^2. This figure is probably applicable to lower elevation rangelands found on the Moab, Richfield, Price and Cedar City BLM Field Offices as well. Coyote densities in the mountainous regions are likely similar.

Estimating coyote populations for the State is based on coyote density multiplied by the number of square miles of each land type. Because autumn population densities are used, this in no way suggests a maximum population. Minimum populations occur immediately before coyote whelping, while maximum populations occur immediately after whelping. Connolly (Unpubl. Rprt. 1994), noted that in stable populations, mortality must equal natality. For this exercise, we attribute one half the annual mortality, in a stable population as occurring between whelping (maximum population) and autumn, and the other half of the mortality occurring between autumn and the following whelping season. Connolly's discussion with respect to maximum and minimum populations is as follows: "Modeling studies have shown that a lightly harvested population with 97 coyotes at breeding (pre-whelping) would be expected to produce 107 pups for a total of 204 animals in the maximum (post-whelping) population (Connolly and Longhurst 1975). In this stable or average population, annual natality equals mortality so that 107 coyotes must die annually. If half these deaths occur before September (autumn), Connolly and Longhurst's (1975) September population would contain 204 – (107/2) = 150.5 coyotes. Thus for every coyote present in September, the maximum (post-whelping) population contains 204/150.5 =1.36 coyotes. Similarly, the minimum (pre-whelping) population contains 97/150.5 = 0.64 animals for every one present in September." Thus it follows that our maximum population numbers for the state are 1.36 times the autumn population, and the minimum population is 0.64 times the autumn population.

Many authors have estimated coyote populations throughout the west and elsewhere (Pyrah 1984, Camenzind 1978, Knowlton 1972, Clark 1972, USDI 1979). The total coyote population in Utah can be estimated by using scientific modeling. The estimated maximum coyote population for the state of Utah is 115,463, based on 1.36 coyotes/mi$^{2.}$ The estimated minimum coyote population using density figures of 0.64 coyotes/mi^2 is 54,335. UDWR estimates the statewide coyote population at about 100,000 (L. McFarlane UDWR, pers. Communication, 2016). Under Alternative 1, we anticipate annual take of coyotes by WS-Utah to be less than 5,000, accounting for annual variability. This take represents 5% of the estimated population, which studies estimate can withstand annual take of at least 60%.

UDWR estimates the total 2011 coyote take for public hunters and trappers in Utah, based on trapper questionnaires, at 7,836 coyotes (UDWR). In July of 2012, the UDWR implemented a general coyote-control program that uses members of the public to take coyotes for mule deer protection. From July 2012 through June 2013, 7,160 coyotes were harvested and bountied through this program, in 2014, 7,041, and in 2015, 8,192 coyotes were bountied. In 2015, the state estimates another 2,903 coyotes were harvested by the public that were not turned in for payment. An additional 305 coyotes were taken through the general predator control program with 11 private individuals that contracted with the UDWR to target coyote removal in specific locations for mule deer protection.

Coyote Population Impact Analysis

Data on the WS-Utah coyote take is available for 2007 through 2015. Comparative sport harvest and other take data in Utah can only be estimated as coyotes are not protected and reporting is not mandatory. For these reasons, UDWR 1999-2004 estimated take data will be used to examine statewide potential impacts on coyote populations. The coyote population estimate, made in this document (2.4.1), will be used as a baseline as it is the best data available and is assumed stable for purposes of comparison. It should also be noted that the level of "*Other Take*" reported to UDWR may be low because the reporting of coyotes killed is not required. Table 4-1 displays the known information about coyote abundance and harvest by WS-Utah from 2010 through 2015.

A population model developed by Pitt *et al*. (2001) assessed the impact of removing a set proportion of the coyote population in one year and then allowing the population to recover (referred to as "pulse removal"). In the model, all populations recovered within 1 year when <60% of the population was removed. The population recovered within 5 years when 60-90% of the population was removed. The authors stated that actual coyote populations would recover even more quickly than the model indicated, because the model made several conservative assumptions: (1) coyote territories were retained even at low densities, (2) animals would not move out of their territories to mate, (3) no animals moved in from surrounding areas (no immigration), and (4) natural mortality rates were not reduced at low population densities. Assumptions like these are generally necessary in order to simplify population models, but in this case, each assumption removes a biological function which would serve to help the population recover more quickly.

Pitt *et al*. (2001) also evaluated the impact of removing a set proportion of the population every year for 50 years ("sustained removal"). When the removal rate was <60% of the population, the population size was the same as for an unexploited population. However, a shift in population structure was noted. For example, the population with 50% removal had fewer transient animals, a younger age structure, and higher reproduction. Sustained removal rates of >70% of the population resulted in removal of the entire population after 7 years in the model, but the authors acknowledged that annual removal of 70% of the population would become increasingly difficult at low densities.

Because of the model limitations described above, natural populations are probably able to withstand greater levels of sustained removal than their model indicated as well. An earlier model developed by Connolly and Longhurst (1975), and revisited by Connolly (1995), indicated that coyote populations could withstand an annual removal of up to 70% of their numbers and still maintain a viable population. For this EA, we will use the lowest reported long-term sustainable harvest rate (60%) as a conservative estimate. This means that the coyote population will not be negatively affected if less than 60% of the population is removed annually, and that any rate below 60% can be continued in perpetuity with no deleterious effect. Harvest rates above 70% would also not affect the statewide population, as long as they are not continued long-term. Based on this information, WS-Utah adverse effect on the coyote population, even with possible "Other Harvest" under reporting, will not have a significant affect on the coyote population in Utah because the "Total Take" of coyotes in Utah is less than 15% for the years analyzed in this EA.

Table 4-1. WS-Utah Coyote Harvest Data.

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	100,000	100,000	100,000	100,000	100,000	100,000
WS-Utah Take During PDM Activities	3,726	4,035	3,460	3,338	2,577	3,195
Estimated Other Take (including bounty coyotes)	6,674	8,128	5,296	10,549	9,959	11,400
WS-Utah Take During PDM Activities (% of population)	3.7%	4.0%	3.5%	3.3%	2.6%	3.2%
Other Take (% of population)	6.7%	8.1%	5.3%	10.6%	10%	11.4%
Total Take (% of population)	10.4%	12.2%	8.8%	13.9%	12.6%	14.6%

*Estimated Other Take Data is from UDWR-Utah Furbearer Harvest Resport 2014-2015 and UDWR-Utah Predator Control Program Summary

4.3.1.2 Black Bear Population Information

Black bears occur throughout much of Utah except in the highly developed Wasatch front portion and desert areas in the west and southern part of the state. Bears present problems concerning livestock predation, property damage, and threats to public safety and nuisance situations in Utah.

Female black bears generally reach reproductive maturity at about 3.5 years of age. Following a 7-8 month gestation period (about 220 days), they produce from one to four cubs in Utah, with two young per litter being most common. Annual mortality is greatest in the juvenile age classes, with orphaned cubs having the highest mortality; mortality in adult black bears is 10% to 20%.

The WS-Utah predation management program does not "take" or modify habitat and thus has no direct impact on connectivity of populations. However, connectivity has been identified as important for population viability and genetic diversity (Frankham 1995). Black bear have a demonstrated ability to disperse long distances across varied terrain and should be considered as one meta-population. While black bear are typically slow to pioneer into new unoccupied habitat, bears have been known to disperse long distances, especially during periodic drought, thus ensuring population connectivity.

Black bear are distributed throughout Utah, but are considered highest in the Book Cliffs, LaSal Mountains, Boulder Mountain, Wasatch Mountains, Manti Mounatins and the Blue Mountains. The current state-wide population is estimated to be 4,100, animals (L. McFarlane, UDWR, pers. Comm. 2016). The UDWR manages black bear populations under a strategic management plan (UDWR 2015) adopted by the UWB. The plan establishes management objectives for populations, establishes that bear populations are a meta-population with interchange between hunting units and provides that black bears causing damage to livestock may be killed by livestock owners, their employees or by employees of the WS-Utah program, or bears posing a threat to human safety may be killed by employees of the WS-Utah program. WS-Utah actions to reduce black bear damage is under the authority of that plan, UWB policy and AWDPB policies, which establish the State's desire (*i.e., status quo)* for management of black bear in Utah. In addition to the strategic management plan, the UDWR may request that WS-Utah remove additional bears to help meet goals and other management objectives in specific areas as they deem necessary.

Black Bear Population Impact Analysis

Data on WS-Utah and non-WS-Utah black bear kills are available for 2010 through 2015 Statewide, the estimated black bear population has remained stable to increasing at about 4,100 black bear Statewide (L. McFarlane, UDWR, pers. Comm. 2016).

The allowable harvest (kill) level for black bear described by the UDWR is about 10% of the population. Age structure and sex ratios of the kill, however, may affect the recommended bear harvest (UDWR 2015). Clark and Smith (1994) estimated sustainable yield of 26% for a location in Arkansas with good bear habitat, though they noted that this level may not be able to maintained indefinitely. Other published rates have been as low as 14.2-15.9% based on models (Miller 1990). For this analysis, we will use the lowest reported sustainable harvest threshold (~14%) as a conservative estimate

During 2010 through 2015 WS-Utah take of black bears was 52, 39, 44, 27, 54, and 36 respectively or about 1.3%, 1.0%, 1.1%, .7%, 1.3% and .87% of the estimated population (Table 4-2). This level of WS-Utah take is well below the allowable harvest level of 10-20% (L. McFarlane, UDWR, pers. Comm. 2016) and is judged that this is a "low magnitude" of harvest. The total kill of black bear for 2010 through 2015 represents 5.4%, 5.5%, 7.1%, 7.0%, 9.2% and 9.2%, respectively of the known mortality during the 6 year period. It should be noted that although WS-Utah took a very small proportion of the black bear in relationship to the total population, the effort is considered quite important by WS-Utah and UDWR in resolving black bear damage and protecting public health and safety, and to meet black bear damage management goals.

UDWR has analyzed black bear populations and concluded that the current harvest, whether by hunting, WS-Utah, or unknown, is not causing a decline in the overall state bear population (L. McFarlane, UDWR, pers. Comm. 2016). The data suggest that, statewide, the total known take is about 12.6% of the estimated population in 2014. This level is at or below the parameters of "*low/moderate magnitude*" of impact established in and the UDWR and WS-Utah is having no adverse effect on black bear populations in Utah. Sportsman harvest averaged 238 black bears per year, with a range of 165 to 329. Cumulative take, including depredation and other mortality ranged from 223 to 378, with an average of 296 per year (Table 4-2). This corresponds to an average of 7.2%, with a maximum of 9.2% of the estimated black bear population in Utah. Under Alternative 1, we anticipate cumulative take not to exceed 430 black bears in any year. This corresponds to 10.5% of the estimated black bear population in Utah. 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.

Table 4-2 WS-Utah Black Bear Harvest Data

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	4,100	4,100	4,100	4,100	4,100	4,100
WS Take During PDM Activities	52	39	44	27	54	36
Estimated Other Take	171	185	245	261	324	340
WS-Utah Take During PDM Activities (% of population)	1.3%	1.0%	1.1%	.7%	1.3%	.9%
Other Take (% of population)	4.2%	4.5%	6.0%	6.4%	7.9%	8.3%
Total Take (% of population)	5.4%	5.5%	7.1%	7.0%	9.2%	9.2%

* Estimated Other Take Data is from UDWR- 2015 Utah Black Bear Annual Report

4.3.1.3 Mountain Lion Population Information

Mountain lions have an extensive distribution across North America including Utah. It is the largest member of the cat family in Utah, and is known by several names, including cougar, panther, puma, catamount, but it is most commonly known as mountain lion. Mountain lions inhabit many habitat types from desert to alpine environments, indicating a wide range of adaptability. They are very closely associated with deer and elk because of their dependence upon these species for food.

Female mountain lions typically breed for the first time between 22 and 29 months of age (Ashman et al. 1983) but initial breeding may be delayed until a territory has been established (Hornocker 1970). Mountain lions breed and give birth year-round, but most births occur during late spring and summer following about a 90-day gestation period (Ashman et al. 1983, Seidernsticker et al. 1973, Robinette et al. 1961). One to six offspring per litter is possible, with an average of two to three young per litter.

Mountain lion density primarily results from prey availability and the social tolerance for other mountain lions. Prey availability is directly related to prey habitat quality which directly influences mountain lion nutritional health, and reproductive and mortality rates. Studies suggest that as available prey increases, so do mountain lion populations, and since mountain lions are territorial animals, the rate of population increase tends to decrease as mountain lion density increases. As mountain lion population density increases, mortality rates from intraspecific fighting and cannibalism also increase, and mountain lions disperse into unoccupied or less densely occupied habitat. Where available, livestock can form a portion of the mountain lions prey base and can buffer mountain lion populations (Cunningham et al. 1995).

Mountain lion densities in other States, based on a variety of population estimating techniques, range from a low of about 1/100mi^2 to a high of 24/100mi^2 (Johnson and Strickland 1992). An average density estimate for the western States was 7.5/100mi^2 (Johnson and Strickland 1992). UDWR modeled mountain lion populations in Utah and based on that model, mountain lion populations are stable with a current estimated state-wide population at about 3,000 animals (L. McFarlane, UDWR, pers. Comm. 2016). Temporary decreases in mountain lion populations are linked to increased sport hunting permits, directed by the Utah Wildlife Board (UWB) to strike a balance between estimated high mountain lion densities, low deer densities, and threats to public safety.

Mountain lion populations can sustain moderate to heavy losses of adults and still maintain viable populations. Robinette et al. (1977) reported an annual mortality of 32% in Utah while Ashman et al. (1983) noted a sustained annual mortality of at least 30% in Nevada. Ashman et al. (1983) believed that under "Moderate to heavy exploitation (30%-50% removal) mountain lion populations on their study area had the recruitment (reproduction and immigration) capability to replace annual losses rapidly."

The WS-Utah PDM program does not "take" or modify habitat and thus has no direct impact on connectivity of populations. However, connectivity has been identified as important for population viability and genetic diversity (Frankham 1995). Mountain lions have a demonstrated

ability to disperse long distances across varied terrain, and in some cases through large fragmented habitats (Stoner et al. 2006)
.
Logan et al. (1996) reported that the rate of increase in the unhunted, uncontrolled population in the San Andres mountains averaged 17%/year for the first 4 years of the study, and then dropped to 5%/year for the last 4 years. The authors believed the slowing of the rate of increase was because the population approached carrying capacity or that carrying capacity dropped because of lower prey availability resulting from drought. The average rate of increase for the population was about 11% over the entire study (Logan et al. 1996). The authors recommended that to maintain a sustained harvest of mountain lions, annual harvest should not exceed 8% of the adult males and the harvest of females should be strictly controlled. The senior author of the study suggested a maximum allowable harvest level would be 11% of the adult portion of the population (letter dated May 6, 1997 from K. Logan, Hornocker Wildlife Institute to E. Jennings, Animal Protection of NM).

The UDWR manages mountain lion populations under a strategic management plan (Utah Mountain Lion Strategic Plan 2015-2025) adopted by the UWB. The plan establishes management objectives for populations of mountain lions within the limits of habitat and prey base, establishes that mountain lion populations are a meta-population with interchange between 4 large ecoregions subdivided into 30 hunting units. The plan also affords that mountain lions causing damage to livestock may be killed by livestock owners or their employees or by employees of the WS-Utah program or mountain lions posing a threat to human safety may be killed by employees of the WS-Utah program in coordination with the UDWR. WS-Utah actions for reducing mountain lion damage are under the authority of that plan, UWB policy and AWDPB policies, which establish the State's desire and objectives (*i.e.,* status quo) for management of mountain lions in Utah. In addition to the strategic management plan, the UDWR may request that WS-Utah remove additional mountain lions to help meet goals and other management objectives in specific areas as they deem necessary.

Mountain Lion Population Impact Analysis

The allowable annual harvest level for mountain lions, (Table 4-3) is 30% of the population, however, the UDWR mountain lion population model indicates that mountain lion populations will remain stable with human caused mortality at 25% of the harvestable population that includes males, females without kittens and transients (L. McFarlane, UDWR, pers. Comm. 2016).

The available data suggest that WS-Utah take 2010 through 2015 was 23, 15, 32, 15, 20 and 13 animals; an average of about .70% of the total estimated population during the six year period (Table 4-3). Under Alternative 1, we anticipate cumulative take not to exceed 430 mountain lions in any year. This corresponds to 14.3% of the estimated mountain lion population in Utah. These levels of cumulative take are expected to have a negligible impact on most local mountain lion populations, and no impact on the statewide population. These figures are within the parameters for a determination of "low magnitude" of impact and serve to achieve the management goals of the UDWR and UWB. This impact analysis suggests that WS-Utah PDM conducted state wide and other harvest are not having any adverse effect on mountain lion populations in Utah.

Table 4-3. Utah Mountain Lion Harvest Data

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	3,000	3,000	3,000	3,000	3,000	3,000
WS-Utah Take During PDM Activities	23	15	32	15	20	13
Estimated Other Take	337	384	352	341	356	359
WS-Utah Take During PDM Activities (% of population)	.8%	.5%	1.1%	.5%	.7%	.4%
Other Take (% of population)	11.2%	12.8%	11.7%	11.4%	11.9%	12%
Total Take(% of population)	12%	13.3%	12.8%	11.9%	12.5%	12.4%

* Estimated Other Take Data is from UDWR- 2015 Utah Cougar Annual Report

4.3.1.4 Bobcat Population Information

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). Reported bobcat densities, as summarized by McCord and Cardoza (1982), have ranged between 0.1-7.0/mi^2. They may live up to 14 years, but annual mortality is as high as 47% (Rolley 1985). Analysis of Utah bobcat harvest data suggests that populations are healthy, productive and stable and that current harvest levels are not detrimental to bobcat populations (L. McFarlane, UDWR, pers. Comm. 2016). Knick (1990) estimated that bobcat densities on his study area in southeastern Idaho ranged from 0.35/mi^2 during a period of high jackrabbit densities, to about 0.04/mi^2 during a period of low jackrabbit densities. Bailey (1974) estimated bobcat densities in the same area to average about 0.14/mi^2.

Bobcat Population Impact Analysis

Bobcats taken by private hunters and trappers averaged 1,941 animals per year from 2004 to 2014. WS-Utah averages taking less than two bobcats per year during FY 2011 to FY 2014 while conducting PDM activities. A bobcat population model developed by Knick (1990) based on 7 years of intensive bobcat research in southeastern Idaho indicated that bobcat populations can sustain harvest levels of up to 20% of the population. Rolley (1985) also estimated that bobcats can sustain a 20% annual harvest. The take of less than two bobcats per year by WS-Utah would represent 0.77% of the statewide total trapper harvest. WS-Utah expects the annual level of take of bobcats to remain similar to previous activities and will not likely exceed 15 bobcat per year. Based on the finds of Rolley (1985), the number of bobcats lethally removed by WS-Utah is unlikely to reach a magnitude where adverse effects would occur to the bobcat population.

4.3.1.4 Red Fox Population Information

Red fox are the most common and well-known species in the genus *Vulpes* and are the most widely distributed nonspecific predators in the world (Voigt 1987). Fox are regarded as nuisance predators in many regions, preying on wildlife and livestock, and have become notorious in many areas of the world as carriers of diseases (Ables 1969, Andrews et al. 1973, Tabel et al. 1974, Tullar et al. 1976, Pils and Martin 1978, Sargeant 1978, Voigt 1987, Allen and Sargeant 1993). Because of its importance to humans, it has been the subject of much study during the last 30 years. Investigations have revealed that red fox are extremely adaptive with much diversity in their behavior and habitats. Voigt and Earle (1983) showed that red fox avoided coyotes but coexisted in the same area and habitats.

The density of red fox populations is difficult to determine because of the species secretive and elusive nature. However, the red fox has a high reproductive rate and dispersal capacity similar to coyotes, and can withstand high mortality within the population (Allen and Sargeant 1993, Voigt 1987, Voigt and MacDonald 1984, Harris 1979, Pils and Martin 1978, Storm et al. 1976, Andrews et al. 1973, Phillips and Mech 1970). Storm et al. (1976) stated that 95% of the females (43.6% were less than 1 year old) bred successfully in a population in Illinois and Iowa. Rowlands and Parkes (1935) and Creed (1960) reported that male red fox breed in their first year. Litter sizes averaged about 4.7 for 13 research studies and litters with as many as 14 and 17 offspring have been reported (Storm et al. 1976, Voigt 1987). Ables (1969) and Sheldon (1950) reported that more than one female was observed at the den and suggest that red fox have "*helpers*" at the den, a phenomena observed in coyotes and other canids. Reported red fox population densities have been more than 50/mi^{2}. (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986) where food was abundant; Ontario population densities are estimated at 2.6 animals/mi^2 (Voigt 1987), and Sargeant (1972) reported 1 fox den/3 mi^2. Prior to European settlement red fox were likely present in Utah but all historical records indicate they were present only at high elevations (Durrant 1952). Increases in red fox populations and their potential impacts on sage-grouse are also considered and addressed in recently revised sage-grouse management guidelines (Connelly et al. 2000), which now include a recommendation that red fox populations should be discouraged in sage-grouse habitat.

The WS-Utah PDM program does not modify habitat and thus has no direct impact on connectivity of populations. However, connectivity has been identified as important for population viability and genetic diversity (Frankham 1995). Red fox dispersal serves to replace and equalize fox densities over large areas and over a wide range of population densities.

Annual harvests in localized areas in one or more years will likely have little impact on the overall population in subsequent years, but may reduce localized predation (Allen and Sargeant 1993). Phillips (1970) stated that fox populations are resilient and in order for fox control operations by trapping to be successful, pressure on the population must be almost continuous. Phillips (1970) and Voigt (1987) further state that habitat destruction that reduces prey numbers; water and cover will affect fox populations to a greater extent than a short-term over harvest.

Red fox are unprotected wildlife in Utah, however trappers and hunters may report harvest to the UDWR voluntarily. Harvest is not limited, so accurate harvest counts are not available. UDWR does track red fox population numbers.

Red Fox Population Impact Analysis

The estimated red fox population in Utah is about 68,000 animals. Using 2010 through 2015 the estimated "Take" by fur trappers as the basis of non-WS-Utah "Take", the "Total Take" of red fox in 2010, 2011, 2012, 2013, 2014 and 2015 was 2,657, 2,864, 2,273, 2,056, 2,517, and 2,272 animals in Utah respectively (UDWR Fur Bearer annual report 2015). The WS-Utah take of red fox in 2010 through 2015 was 134, 168, 85, 93, 40 and 66 animals in Utah. WS-Utah does not anticipate needing to take more than 300 red fox/year, equaling 13.6 % of the reported trapper hunter harvest (UDWR 2011).

The magnitude of impact is determined to be low and there is no adverse effect on red fox populations in Utah.

Table 4-5. Utah Red Fox Harvest Data for 2010 through 2015.

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	68,000	68,000	68,000	68,000	68,000	68,000
WS-Utah Take During PDM Activities	134	168	85	93	40	66
Estimated Other Take	2,657	2,864	2,273	2,056	2,517	2,272
WS-Utah Take during PDM Activities (% of population)	0.2%	0.25%	0.13%	0.14%	0.06%	0.1%
Other Take (% of population)	3.9%	4.2%	3.3%	3.0%	3.7%	3.3%
Total Take (% of population)	4.1%	4.5%	3.5%	3.2%	3.8%	3.4%

* Estimated Other Take Data is from UDWR Utah Furbearer Annual Report 2014-2015

4.3.1.5 Kit Fox Population Information and Impact Analysis

Kit fox distribution falls within the great basin region of western Utah. WS-Utah rarely takes kit fox in PDM activities because few complaints are ever received for them. WS-Utah kit fox take from 2010-2015 was 2 in 2015. Private harvest from 2010-2015 averaged 123/ year (UDWR Fur Bearer annual report 2015). Published estimates of kit fox density vary from 1/43 ha (106 acres) in California to 1/1,036 ha (2,560 acres) in Utah (O'Farrell 1987). Assuming that kit fox population densities in Utah fall at the low end of those recorded in the literature (0.25-6/mi^2) or 1/2mi^2 which is fairly conservative, then a moderate population density estimate would be about 15,000 kit fox. The peak cumulative take (private and WS-Utah) of 373+WS… kit fox in 2013 in Utah is about 2.5% of their projected population. Therefore, if WS-Utah were requested by UDWR to assist with PDM efforts for kit fox, take would have to be substantially higher before it would impact the population.

Table 4-6. Utah Kit Fox Harvest Data for 2010 through 2015.

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	15,000	15,000	15,000	15,000	15,000	15,000
WS-Utah Take During PDM Activities	0	0	0	0	0	2
Estimated Other Take	51	45	110	373	14	145
WS-Utah Take during PDM Activities (% of population)	0%	0%	0%	0%	0%	.013%
Other Take (% of population)	.34%	.3%	.73%	2.5%	.09%	.96%
Total Take (% of population)	.34%	.3%	.73%	2.5%	.09%	.973%

* Estimated Other Take Data is from UDWR Utah Furbearer Annual Report 2014-2015

4.3.1.6 Gray Fox Population Information and Impact Analysis

WS-Utah rarely takes gray fox for PDM, and over the last 5 years there has been no gray fox take by WS-Utah. Statewide private harvest, as reported by UDWR averaged 1,153/year from 2010-2015 (UDWR Fur Bearer annual report). Published estimates of gray fox density range between 3.1 and 5.4/mi^2 (Trapp 1978). Since populations tend to be scattered over the south and south eastern portions of Utah in suitable habitat, they conservatively may be found in pockets covering about 30% of the State. Using the low density estimate and low range of habitat hypothetically used, a conservative estimate of gray fox abundance would be about 65,000 in Utah. An allowable harvest level for gray fox is 25% of the total population or 16,000 per year. The peak (private) cumulative take of 1,392 gray fox in 2010 in Utah was about 8.7% of that allowable harvest level which is clearly insignificant to gray fox populations. If WS-Utah were requested by UDWR to assist with greater PDM efforts for gray fox, take would have to be at a high magnitude before it would impact the population.

Table 4-7. Utah Gray Fox Harvest Data for 2010 through 2015.

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	65,000	65,000	65,000	65,000	65,000	65,000
WS-Utah Take During PDM Activities	0	0	0	0	0	0
Estimated Other Take	1,392	907	1002	1288	1318	1015
WS-Utah Take during PDM Activities (% of population)	0%	0%	0%	0%	0%	0%
Other Take (% of population)	2.1%	1.4%	1.5%	1.9%	2%	1.6%
Total Take (% of population)	2.1%	1.4%	1.5%	1.9%	2%	1.6%

* Estimated Other Take Data is from UDWR Utah Furbearer Annual Report 2014-2015

4.3.1.7 Badger Population Information

Badgers are a native predatory species and that is protected by State law, but they can be taken when causing damage or nuisance problems (Utah Admin. Rule R657-11-21). There is no bag limit on badgers during the furbearer season (September 26, 2015 through Feb. 14, 2016). Little is known about badger densities other than a few intensely studied populations, but they are considered demonstrably widespread, abundant, and secure in Utah (Lindzey 1978, Lindzey 1982). Lindzey (1971) estimated that the Curlew Valley on the Utah-Idaho border supported 1/mi2 and Messick and Hornocker (1981) found 13/mi2 in southwestern Idaho and noted that densities may be higher during periods when juveniles are dispersing. Densities of 5 badger/mi^2 were recorded in the National Elk Refuge in northwestern Wyoming (Lindzey 2003). For purposes of this analysis, we will conservatively use the low density estimate of 1/mi2 for Utah statewide, or about 84,899 badgers. Understanding that some acreage will not support badger habitat due to anthropogenic development.

Badger Populations Impact Analysis

An average of 325 badgers are taken each year by private trappers (Utah Furbearer Annual Report 2010-2015). From 2010-2015 WS-Utah annual badger take averaged 2.8/year, and averaged about .9% of the total take. WS-Utah activities related to badger management would be coordinated with the UDWR to insure no negative impacts on badger populations. Badgers may negatively impact the threatened Utah prairie dog reintroduction efforts, so their removal is likely to be beneficial for the reintroduction efforts in terms of improving habitat conditions for Utah prairie dog recovery and conservation.

Sustainable harvest for badger populations has been estimated at 30-40% annually (Boddicker 1980) or about 25,469 to 33,960 in Utah. WS-Utah expects the annual take of badgers to remain similar to previous activities, including nontarget removal with maximum annual removal not likely to exceed 100 badgers per year. Based on the limited take that could occur, impacts of WS-Utah actions would be of very low magnitude. Cumulative impacts on the badger population from all known sources of mortality are also very low and well below sustainable limits for the population (Table 4-8).

Table 4-8. Utah Badger Harvest Data for 2010 through 2015

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	84,899	84,899	84,899	84,899	84,899	84,899
WS-Utah Take During PDM Activities	6	2	0	5	7	9
Estimated Other Take	334	309	217	302	371	417
WS-Utah Take during PDM Activities (% of population)	0.007%	0.002%	0%	0.006%	0.008%	0.01%
Other Take (% of population)	0.39%	0.36%	0.26%	0.36%	0.44%	.49%
Total Take (% of population)	0.40%	0.37%	0.26%	0.362%	0.45%	.5%

* Estimated Other Take Data is from UDWR Utah Furbearer Annual Report 2014-2015

4.3.1.8 Raccoon Population Information

Raccoons are one of the most omnivorous animals, feeding on carrion, garbage, birds, mammals, insects, crayfish, mussels, a wide variety of grains, various fruits, other plant materials and most or all foods prepared for human or animal consumption (Sanderson 1987). Raccoon populations vary considerably, depending on food availability and habitat suitability and populations can vary widely between seasons and years due to disease and harvest (Gehrt 2003). Raccoons generally do well in human-altered areas and the highest reports of raccoon densities usually occur in urban/suburban areas. Typical rural densities run from 2.6-70 raccoons per square mile with lowest densities (1-2.6) usually occurring at the northern edge of the species range (Gehrt 2003). Population densities of raccoons in the Rolling Plains ecological region of Texas was estimated at 43/mi^2 (USDA 2013). In Utah, the estimated population is unknown, but the population is robust (L. McFarlane, UDWR, pers. comm. 2016), and raccoons are considered unprotected wildlife not managed by the UDWR. For the purpose of this EA we are using the most conservative average raccoon density estimate of 1/mi^2, which would indicate a statewide population estimate of more than 84,899 raccoons.

Previous to 1970, raccoons in Utah only occurred in isolated areas (Durrant 1952). Raccoons are very opportunistic in behavior, and have adapted and expanded their populations throughout Utah and much of the west. In a study looking at range expansion of raccoons in western Utah and Nevada, Kamler et al. 2003 found that raccoon harvest in Utah has been documented in Utah by the UDWR since 1982, and before that time, raccoons had not been documented in Tooele, Juab, Millard, Beaver, and Iron counties. Raccoons have now been documented in every county in Utah.

Because of their ability to adapt to human environments, raccoon population demographics tend to increase in urban setting due to increased anthropogenic food supplies (Prange et al. 2003). Raccoons, are now common in most urban settings throughout Utah, and have been found in high densities along the Wasatch Front. In 2013, WS-Utah removed about 141 urban nuisance raccoons from Salt Lake County, and in cooperation with other federal and state agencies, an additional 123 raccoons where removed from state and federal waterfowl management areas prior to and during the nesting season. In 2014, WS-Utah did not continue to provide urban raccoon removal services along the Wasatch Front. In 2016, a new cooperative agreement was formed among several cities in Salt Lake County to continue the removal of urban nuisance raccoons, and does not expect to exceed removing more than 1,400 raccoons/year.

From 2004-2014, an average estimate of 4,765 raccoons where harvested in Utah on an annual basis, with a high of 6,405 harvested in 2005 (Utah Fur bearer annual report 2004-2014). The UDWR reported about 5,482 raccoons harvested by fur trappers in Utah in 2013-2014.

Raccoon Population Impact Analysis

By agreement, WS-Utah assists the UDWR when requested and, thereby, requests from the public regarding potentially dangerous wildlife would be referred to WS-Utah. These requests are given a high priority and scrutinized using the WDM Decision Model (Slate et al. 1992). WS-Utah only conducts raccoon damage management at the request of home/land owners, resource managing agencies or leases and in concurrence with land management plans or comparable documents.

WS-Utah expects its annual take of raccoons to not exceed 2,500 individuals/year or 2.9% of the population (Table 4-9), and will not have a negative on the total population. Cumulative impacts on the raccoon population from all known sources of mortality are also very low. Substantial undocumented mortality likely occurs, but that mortality would have to be close to ten times the level of documented mortality for the population to reach levels close to the limit conservatively estimated sustainable level for the State population. Given the wide distribution and relative abundance of raccoons in the state and the ability of raccoons to thrive in human-altered landscapes, cumulative impacts will not adversely impact the Utah raccoon population.

Table 4-9. Utah Raccoon Harvest Data for 2010 through 2015.

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	84,899	84,899	84,899	84,899	84,899	84,899
WS-Utah Take During PDM Activities	1,201	792	534	264	84	100
Estimated Other Take	5,018	5,946	4,141	6,239	5,482	5,437
WS-Utah Take during PDM Activities (% of population)	1.4%	.9%	.6%	.3%	.1%	.12%
Other Take (% of population)	5.9%	7%	4.9%	7.3%	6.5%	6.4%
Total Take (% of population)	7.3%	7.9%	5.5%	7.6%	6.6%	6.5%

* Estimated Other Take Data is from UDWR Utah Furbearer Annual Report 2014-2015.

4.3.1.9 Striped Skunk Population information

Stripped skunk densities can be highly variable depending on habitat quality, with densities reported in the literature range from 0.26 to 67/mi^2 (Ferris and Andrews 1967, Verts 1967, Lynch 1972, Bjorge et al. 1981, Broadfoot et al. 2001, Hansen et al. 2004). Many factors may contribute to the widely differing population densities, including type of habitat, food availability, disease, season of the year and geographic area (Storm and Tzilkowski 1982). Specific population density estimates for striped skunks in Utah are not available. For purposes of this analysis, we will conservatively estimate skunk densities at 0.3/mi^2 throughout Utah, for an estimated population of about 25,470 animals.

Stripped skunks are native to Utah and are found throughout the state. Higher population densities are often found near mesic zones; riparian corridors and wetlands etc. Currently, there are no trapping restrictions for stripped skunks in Utah.

Some regions along the Wasatch front experience periods of abnormally high stripped skunk reproduction due to anthropogenic changes to habitat and increased food supply in urban settings. For example, in 2011, WS-Utah removed over 20 skunks over a 2 week period from one property owner in Magna. In 2013, WS-Utah removed 44 nuisance stripped skunks from Salt Lake County, and in cooperation with other federal and state agencies, an additional 20 stripped skunks where removed from state and federal waterfowl management areas prior to and during the nesting season. In 2014, WS-Utah did not continue to provide urban skunk removal services along the Wasatch Front. In 2016, a new cooperative agreement was formed among several cities in Salt Lake County to continue the removal of urban nuisance skunks.

From 2004-2014, an average estimate of 1,963 stripped skunks where harvested in Utah on an annual basis, with a high of 3,270 harvested in 2010 (Utah Fur bearer annual report 2013-2014). The UDWR reported about 1,970 stripped skunks harvested by fur trappers in Utah in 2013-2014.

Skunk Population Impact Analysis

WS-Utah only conducts skunk damage management at the request of home/land owners, resource managing agencies or leasees and in concurrence with land management plans or comparable documents. WS-Utah conducts raccoon and skunk damage management on about 35,000 acres of the 84,899 mi^2 that encompasses Utah, or less than 0.06% of the State.

The highest annual take in the last six years by WS-Utah represents less than 2.5% of a population in Utah at 25,470 striped skunks (Table 4-10). Striped skunk populations can sustain an annual harvest rate of 60% annually (Boddicker 1980) or about 15,282 in Utah. WS-Utah expects the annual take of striped skunks to remain similar to previous activities, including nontarget removal. Based on the limited removal that could occur, impacts would be of very low magnitude. Additionally, should WS-Utah's requests to remove striped skunks increase substantially, the cumulative impacts to the striped skunk population would remain low and don't anticipate removing more than 1,100 skunks ins any given year.. Cumulative impacts of known take on the skunk population are also low relative to sustainable harvest levels. Given the wide distribution and relative abundance of the striped skunk population and the capacity of the species to adapt to human-altered landscapes, this alternative will not have an adverse cumulative impact on the striped skunk population.

Table 4-10. Utah Striped Skunk Harvest Data for 2010 through 2015.

Population Statistics	2010	2011	2012	2013	2014	2015
Estimated Population	25,470	25,470	25,470	25,470	25,470	25,470
WS-Utah Take During PDM Activities	635	463	348	64	12	72
Estimated Other Take	3,270	2,733	1,679	2,465	1,970	1,875
WS-Utah Take during PDM Activities (% of population)	2.5%	1.8%	1.4%	.25%	.05%	.28%
Other Take (% of population)	12.8%	10.7%	6.6%	9.7%	7.7%	7.3%
Total Take (% of population)	15.3%	12.5%	8%	9.95%	7.75%	7.6%

* Estimated Other Take Data is from UDWR Utah Furbearer Annual Report 2014-2015.

4.3.1.10 Feral Cat Population Information

Feral cats are common in many parts of Utah, especially close to human habitation. Feral cats are not part of the native environment and when left abandoned in the wild, they are considered an ecological pest and very efficient predators killing millions of native wildlife annually (ABC 2015) and competing with native predators. Domestic cats have been either a direct or indirect factor in 33 bird species extinctions and have been identified by the science community as one of the world's worst invasive species (ABC 2015). Scientists from the Smithsonian Conservation Biology Institute and the USFWS estimate that approximately 2.4 billion birds and 12.3 billion mammals are killed in the United States by outdoor cats ever year (ABC 2015). Primary responsibility for addressing damage or threats of damage caused by feral cats occurs with county agencies, local authorities or the resource owner/manager. There are an estimated 30 million feral cats (Luoma 1997) and an estimated 63 million pet cats (Nassar and Mosier 1991) in the continental United States (Pimentel et al. 2000).

WS-Utah infrequently receives requests for assistance associated with feral cats and had only 9 threat occurrences to nesting waterfowl caused by feral cats between 2010 through 2015. The majority of complaints received with feral cats is predation on nesting waterfowl and poultry. As part of those requests for assistance, WS-Utah lethally removed 9 cats between 2010 and 2015 to alleviate damage or threats of damage. Between FY 2010 and FY 2015, WS-Utah lethally removed one feral cat unintentionally during activities targeting other predators.

Feral Cat Impact Analysis

Executive order 13112 directs federal agencies to, amongst other things, work within the capacity of available resources and agency mission and authorities to control populations of invasive species. However, WS-Utah does not anticipate the lethal removal of feral cats to exceed 30 cats per year. Based on the limited number of animals taken and infrequent nature of lethal removal that could occur, including non-target removal, impacts would be nonexistent or of very low magnitude. The limited removal of feral cats by WS-Utah would have minimal effects on statewide populations. Some local populations may be temporarily reduced at a specific site if cats were removed using nonlethal (cage trapping) or lethal methods. In those cases where feral cats were causing damage or were creating a nuisance and complete removal of the local population could be achieved, this could be considered as providing some benefit to the natural environment because feral cats are not considered part of the native ecosystem. The lethal removal of cats that could occur by WS-Utah would be minor compared to the number killed by animal control and humane organizations in Utah each year.

4.3.1.11 Feral Dog Population Information

Feral, free-ranging hybrid dogs are somewhat common in Utah and damage associated with these dogs can be extensive. Domestic dogs kill or injure livestock, wildlife, and poultry and present a problem for human health and safety (*e.g.*, attacks and disease threats). In 2016, WS-Utah documented three cases of damage with feral dogs. Damage or threat occurrences were associated with livestock. Feral dogs killed or injured one sheep, one lamb, and two horses causing a total of $12,601 in losses. Feral dogs also pursue and prey on native wildlife, such as deer and upland game. Primary responsibility for dog control rests with county and local authorities or the resource owner/manager. However, because of WS-Utah's cooperative WDM responsibilities and the seriousness of the problem, WS-Utah personnel are authorized to control feral dogs for the protection of livestock, poultry and human health and safety. Feral dogs are not part of the native environment and when left abandoned in the wild, feral dogs are often considered ecological concerns because they can prey on native wildlife. The estimated pet dog population in the United States is 77.8 million in 54.4 million homes (American Pet Products Manufacturers Association 2016). However, an unknown percentage of those animals have become wild (Bergman et al. 2009).

Feral Dog Population Impact Analysis

In response to damage and threat occurrences involving dogs, WS-Utah removed one feral dog from FY 2010 to FY 2016. WS-Utah also unintentionally lethally removed one feral dog and trapped and released two more during other damage management activities conducted from FY 2010 and FY 2016. The lethal removal of feral dogs by WS-Utah is considered to have little impact on the human environment because dogs are not an indigenous component of ecosystems in Utah. In addition, the annual removal of dogs by WS-Utah is minor in comparison to the thousands killed by animal control and humane organizations in Utah each year. WS-Utah addresses feral and free-roaming dogs at the request of the local authority for animal control and, thus, this action would likely occur in the absence of involvement by WS-Utah. WS-Utah expects the annual lethal removal of feral dogs in Idaho to remain similar to previous years.

4.3.1.12 Other Predator Species impacts

Other predator species that may cause occasional problems in Utah are mink, long- and short-tailed weasels, spotted skunks, European ferret, American martin, North American river otter, and ringtails. In 2011, WS-Utah removed two short-tailed weasels during PDM activities. WS-Utah receives periodic complaints involving these species and may conduct operational control in the future to take offending animals. Unless equipment is specifically set to capture them, the PDM methods mostly used by WS-Utah excludes these species because of their size and weight. All of these species are found at moderate levels locally within their range in the State.

From 2005-2015, Utah fur harvesters had an annual average take of 458 mink, 62 weasel, 208 spotted skunks, and 77 ringtails, respectively. Even with minimal take by WS-Utah, these populations are highly unlikely to be cumulatively negatively affected by WS-Utah PDM efforts. Therefore, unless a substantive project is proposed that may involves the take of a large number of one of these species (more than 50), WS-Utah will not analyze population impacts further.

4.3.2 Alternative 2 – WS-Utah Operational Lethal Strategies for Corrective PDM and Technical Assistance

Under this alternative, the numbers of coyotes and red fox taken by WS-Utah could decrease and the affects to these species populations could be reduced if their populations are not at carrying capacity. But because WS-Utah take of coyotes and red fox under the current program results in only a low magnitude of impact, the affects on coyote and red fox populations resulting from implementation of a "lethal corrective action only" alternative would not likely differ significantly from the affects of the current program. Effects on black bear and mountain lion populations would be the same as the current program because damage management on those species is conducted on a corrective only basis.

4.3.3 Alternative 3 - Nonlethal Damage Management Only

Under this alternative, W-Utah would not conduct any lethal damage management; therefore there would be no effect from WS-Utah on the target species populations' viability. There would likely be continued effects on some wildlife populations, particularly coyotes and red fox, from other sources to address damage problems. This could take the form of increased private aerial PDM or other damage management efforts by individual livestock producers, and/or the establishment of organized State, county, or private PDM programs. Because WS-Utah current activities result in such a low magnitude of impact on the viability of wildlife populations, it is not expected that these other compensatory forms of PDM would result in significantly different impacts.

4.3.4 Alternative 4 -Technical Assistance Only

Because Alternative 4 does not provide for any operational WS-Utah activities, there would be no WS-Utah program effects on the viability of any target wildlife populations. There would likely be continued effects on some wildlife populations, particularly coyotes and red fox, from other entities that conduct damage management. This could take the form of increased private aerial PDM or other damage management efforts by individual livestock producers, and/or the establishment of organized State, county or private predator damage control programs. Because WS-Utah current activities result in such a low magnitude of impact on the viability of wildlife populations, it is not expected that Alternative 4 would result in significantly different impacts.

4.4 EFFECTS OF WS-UTAH PDM ON NONTARGET SPECIES (INCLUDING T&E AND SENSITIVE SPEICIES)

The USFWS is charged with implementation and enforcement of the ESA. The USFWS cooperates with WS-Utah by recommending measures to avoid or minimize take of any and all T&E species (50 CFR 17.3). Under the ESA, all Federal agencies are charged with a responsibility to conserve T&E species and to utilize their authorities in furtherance of the purposes of the Act (Sec.2(c)). WS-Utah conducts Section 7 consultations with the USFWS to utilize 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* . . ." (Sec.7 (a)(2)). WS-Utah is currently in consultation with the USFWS under Section 7 of the ESA.

4.4.1 Alternative 1 - Current Utah Adaptive Integrated PDM Program for Multiple Resources and Land Classes (No Action /Proposed Alternative)

Alternative 1 allows for an adaptive IPDM program for the protection of livestock, crops, property, specific wildlife species and human health and safety during the implementation of the WS-Utah program. Coordination occurs between WS-Utah and State and Federal land and wildlife managing agencies on a regular basis to insure no adverse effects to listed species. Local populations of some listed species, big game populations, waterfowl and upland game bird populations have benefited from PDM. Through these efforts, wildlife managing agencies have better been able to better meet their objectives for management of selected species where predation is considered a threat to species recovery. Under Alternative 1, WS-Utah nontarget catch and take rates are expected to remain at the level that currently exists.

4.4.1.1 Nontarget Species

Nontarget animals include species that would be unintentionally captured, or for mountain lions or bears, members of the target species that were not involved in the individual depredation incident. The WS-Utah MIS considers nontarget animals "taken" only lethal take is considered. When possible, nontarget species would be released when it is determined that they would survive (APHIS-WS Directive 2.450). The total nontarget take for FY11 through FY15 was 47 animals, of which 19 were released (Table 4-11).

Federally listed T&E animal species that may be affected by WS-Utah PDM activities include the Utah prairie dog, the Mexican spotted owl (*Strix occidentalis lucida*), bald eagle (*Haliaeetus leucocephalus*), black-footed ferret, California condor (*Gymnogyps califorianus*), southwestern willow flycatcher (*Empidonax traillii extimus*), Gunnison sage-grouse (*Centrocercus minimus*) bonytail (*Gila elegans*), humpback chub (*G. cypha*), Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), Virgin River chub (*Gila seminuda= G. robusta seminuda*), woundfin (*Plagopterus argentissimus*), and desert tortoise. Occasionally, Canada lynx may enter the state from Colorado. However, there is no indication that a breeding population of Canada lynx is present in Utah. Where applicable, the Reasonable and Prudent Alternatives for these species have been implemented. During the programmatic consultation, not all of the effects identified were because of the PDM portions of the program. The WS-Utah program also conducted consultation with the USFWS on the 1996 EA. Chapter 3, section 3.5 lists minimization measures and SOPs that would be implemented to insure that no T&E species would be adversely affected by the program.

Several species are considered by UDWR as "sensitive" for a variety of reasons, including limited distribution or declining populations. For this analysis, WS-Utah has determined that no negative effects will occur to State listed fish, mollusks, amphibians, snakes, lizards, bats, rodents and any species listed as extinct. Appendix C lists other State sensitive species which were considered in this analysis.

Table 4-11. Nontarget Animals Taken by WS-Utah by FY.

Species	Number	Method	Disposition
FY 11			
Badger	5	foothold Trap Neck snare	Freed (3) Killed (2)
FY 12			
Badger	10	foothold Trap	Freed (10)
Bobcat	1	foothold Trap	Freed
Porcupine	1	foothold Trap	Killed
FY 13			
Bobcat	1	foothold Trap	Freed
Badger	1	Neck snare	Freed
FY 14			
Badger	4	foothold Trap Neck snare	Killed (3) Killed
Skunk	12	foothold Trap	Killed (12)
Bobcat	1	foothold Trap	Killed
Feral cat	1	foothold Trap	Killed
Mountain Lion	2	Neck snare	Killed (2)
Pronghorn	1	foothold Trap	Freed
FY 15			
Badger	1	foothold Trap	Killed
Bobcat	3	foothold Trap foothold Trap	Freed (2) Killed
Kit Fox	2	foothold Trap	Killed (2)
Moose	1	footholdTrap	Killed

Nontarget animals are individual animals trapped, killed, or injured that were not involved in the depredation situation being resolved, or target species inadvertently killed or injured while attempting to take other target species or individuals. Nontarget animals[22] could include black bears, mountain lions, bobcats, badgers, gray fox, kit fox, striped skunks, western spotted skunks, ringtail, mink, short-tailed weasel, long-tailed weasel, European ferret, American martin, North American river otter, feral cats, and feral dogs. APHIS-WS Policy (WS Directive 2.450) states "*Nontarget animals captured would be released if it is determined that they are physically able to survive.*"

In FY15, WS-Utah personnel killed 1 badger, 1 bobcat, 2 kit fox, and 1 moose. FY 14, WS-Utah personnel killed 4 badgers, 12 skunks, 1 bobcat, 1 feral cat, and 2 mountain lions. In FY 13 no nontarget species were taken by WS-Utah. In FY 12, WS-Utah personnel killed one porcupine (Table 4-11). In FY11, WS-Utah personnel in Utah killed two badgers.

Of the above animals listed as nontarget species, the badger, kit fox, bobcat and striped skunk are considered as furbearers under Utah statutes. Striped skunks and red fox are unregulated furbearers with no restrictions on take. UDWR regulates the take of other furbearers and WS-Utah take is permitted under a Certificate of Registration. Raccoons are considered as *"unprotected"* under state statute (UCA 4-23), and are regulated by the UDAF. No permit is required to kill a raccoon.

The combined six year take of nontarget species is seven badgers, two bobcat, one feral cat, two kit fox, one porcupine, twelve striped skunks, two mountain lions, and one moose. Capture of deer, moose and other ungulates is extremely rare, and if the animal cannot be freed unharmed, then the UDWR is contacted. WS-Utah take of these species represents a small portion of their populations for the five year period. Therefore, the magnitude of this level of take is small and insignificant to these common species. WS-Utah policy will remain to minimize nontarget catches, and employs the policies listed in Section 3.5 for the protection of T&E and sensitive species.

4.4.1.2 Federal T&E Species

No Effect Determinations

WS-Utah finalized consultation with the USFWS under Section 7 of the ESA April 5th 2017. WS-Utah reviewed the current federal T&E listings on (10/13/2016), and determined that PDM methods and activities would have no effect on 23 federally listed (candidate, T&E) plants, fish, mollusks, or amphibians. Additionally, WS-Utah has assisted in the protection of T&E species at the request of the UDWR and USFWS.

May Affect, Not Likely To Adversely Affect Determinations

22 Raccoons and red fox may be incidentally taken. However, because of their invasive status in most of Utah, WS-Utah direction is to not release either species when caught incidental to damage management. By default, raccoons and red fox are target species.

WS-Utah reviewed the current federal T&E listings on (10/13/2016), and determined that PDM methods and activities "***may affect, but are not likely to adversely affect***" 7 federally listed (candidate, T&E) mammals and birds.

The following species are addressed in the consultation and all applicable Reasonable and Prudent Measures will be incorporated in the WS-Utah PDM program. WS-Utah made a May Affect, Not Likely Affect determination for the following species:

Canada Lynx: *Contiguous U.S. population threatened (65 FR 16052; March 24, 2000),*

Canada lynx are medium-sized cats, with long legs, large, well-furred paws, long ear tufts, and a short, black-tipped tail. Adult males average about 30 pounds in weight and females average 19 pounds. The winter pelage of the lynx is dense and has a grizzled appearance with grayish-brown mixed with buff or pale brown fur on the back, and grayish-white or buff-white fur on the belly, legs, and feet. Summer pelage of the lynx is more reddish to gray-brown. The lynx's long legs and large feet make it highly adapted for hunting snowshoe hares (*Lepus americanus*), its primary prey, in deep snow. In the western United States, the distribution of lynx is associated with the southern boreal forests and subalpine coniferous forest; within these general forest types, lynx are most likely to persist in areas that receive deep snow.

Lynx in the western contiguous United States have mostly been rare. Habitat connectivity and fragmentation issues, land and road development, starvation of young because limited prey-base, human –caused mortality, predation by mountain lions, wolves, and coyotes, interspecific competition with coyotes, raptors, and other predators (e.g., competition for snowshoe hares), and diseases such as feline distemper virus, also called feline panleukopenia, an acute, highly infectious viral disease (Wasieri et al. 2009), and canine distemper virus (Daoust et al. 2009, Meli et al. 2010) have all been identified as threats to the lynx. Conservation efforts have included reintroduction efforts in Colorado.

The Southern Rocky Mountain Region (central to western Colorado, northeastern Utah, and southcentral and south western Wyoming) represents the extreme southern edge of lynx range and most are found at or above elevations 8,000 ft. It should be noted that the southern boreal forest of Colorado and southcentral Wyoming is isolated from boreal forest in Utah by the Green River Valley and the Wyoming Basin (McKelvey et al. 2000).

In Utah, Lynx historically occurred in the Uinta Mountains on the Uinta-Wasatch-Cache National Forest (Bunnell et al. 2004). Between 1916 and 1972, there were only 10 confirmed sightings of Canada lynx in the Uinta Mountains between (McKay 1991; McKelvey et al. 2000). Four of the recorded sightings correlated to the cyclic highs of the 1960s and 1970s. Survey efforts for lynx in the Uinta Mountains have been unsuccessful in documenting lynx occurrence (Christina Hacker USFS personal comm. 2017).

From 1999-2007, 22 of the 218 radio-collared lynx reintroduced to the Colorado Rockies by the Colorado Division of Wildlife (CDOW) were documented dispersing through Utah and the Uinta Mountains (CDOW, 2006-2007). The majority of lynx satellite locations occurred within the western half of the mountain range (CDOW, 2007-2008). Lynx that moved through Utah did not take up residency. Although potential for future residency of lynx in the Uinta Mountains is possible, these individual lynx were transient. Prior to these recent lynx occurrences, the last confirmed occurrence of lynx in the Uinta Mountains was in 1972. Lynx are considered dispersers and there is no evidence of lynx reproducing in Utah. They are transient animals to this area and are considered extremely rare in the Uinta Mountains if they even occur (Christina Hacker USFS personal comm. 2017).

The USFS has conducted several surveys since 1999, which includes: (1) National Lynx Detection Protocol hare snare surveys on the Wasatch-Cache NF between 1999-2001; (2) hair surveys 2000-2001 field seasons (USDA Forest Service 2006a); (3) aerial surveys in Colorado River drainage of the North Slope of the Uinta Mountains 2009-2010 (McKay 1991; McKelvey et al. 2000); (4) U. S. Fish and Wildlife Service and FS track surveys conducted in the Uinta Mountains on both Uinta-Wasatch-Cache and the Ashley National Forests 2010-2012 (Berg and Inman 2010, Shenk 2007, and USDA Forest Service 2006a) (FS and Adventurers and Scientists for Conservation forest carnivore summer trail camera study on the North Slope of the Uinta Mountains in 2015; and Evanston-Mountain View RD winter trail camera surveys from 2014-2016).

It was determined that based on habitat requirements, reputable sightings, WS-Utah field experience, and consultations with the UDWR and the USFS, that the potential for incidental lynx take coincided greatest with WS-Utah activities in the Uinta Mountains of northeastern Utah, specifically above 7,200 feet in spruce/fir and lodgepole pine (*Pinus contorta*) habitat, with limited potential in quaking aspen (*Populus tremuloides*) fingers connecting large blocks of timber (WS 2006a). At this time there is no known occupied lynx habitat in Utah and the likelihood of impacts to lynx with the implementation of the PDM program is very unlikely. If established lynx populations in Utah are discovered in the future, WS-Utah will re-consult with the USFWS to determine appropriate PDM actions in occupied lynx habitat. Although, unlikely to occur with the WS-Utah program, the following conservation measures are recommended to reduce impacts to lynx:

Conservation Measures Used to Minimize Incidental Take of Lynx

1. Restrict their normal PDM activities within or near known occupied lynx habitat.

2. Provide training to WS-Utah personnel in the identification of lynx and lynx sign, and snowshoe hare and their sign if conducting PDM activities within occupied lynx habitat.

3. If lynx are discovered to occupy habitat in Utah, WS-Utah personnel will not use fetid baits and attractants in coyote sets within occupied lynx habitat, and will not use such baits within 100 meters of any conifer forest type above 8,000 feet elevation (above sea level).

4. WS-Utah personnel will utilize foothold traps and foot snares set for larger predators (e.g., mountain lions, black bears, and wolves) equipped with pan tension devices sufficient to reduce the likelihood of capturing lynx or other animals up to 35 pounds (e.g., 8 to 10

pound trip weight) within 100 meters of any conifer forest type above 8,000 feet elevation (above sea level) in known occupied habitat.

5. WS-Utah personnel will not set neck snares for coyotes or bobcats within 100 meters of any conifer forest type above 8,000 feet elevation (above sea level) in known occupied habitat.

6. WS-Utah personnel will remove a tracking dog from trailing a lynx.

7. Although there is no known occupied lynx habitat in Utah and the likelihood of capturing a lynx is significantly small, if WS-Utah personnel incidentally captures a lynx, WS-Utah will immediately release any un-injured lynx incidentally captured by any equipment. If a lynx has been non-fatally injured, WS-Utah shall transport the animal to the nearest veterinarian and shall contact USFWS and the UDWR immediately for instructions on the disposition of the animal. If a captured lynx is severely injured and cannot be rehabilitated or safely released, it may be euthanized by WS-Utah and immediately reported to USFWS and UDWR. WS-Utah shall use humane measures to euthanize the injured animal.

8. WS-Utah personnel will report any trapped, treed, lethally taken, or lynx-related observations to the nearest USFWS office and UDWR, including the date, specific location, method of taking or observation, and the nature and extent of any injuries sustained.

9. WS-Utah personnel will notify the USFWS and UDWR within 24 hours if a lynx is killed, and assist in preserving and transporting the carcass to the appropriate State, Federal, or Tribal wildlife agency for biological analysis. Additionally, trailing dogs are to be takenoff a lynx, if they inadvertently change from another target species to a lynx.

WS-Utah, though, only conducts these measures where a lynx has been found because Utah has not had any permanently "occupied habitat[23]" for lynx.

Based on prior history and experience, WS-Utah PDM is highly unlikely to result in incidental take of lynx. Records show that only one lynx was incidentally captured by the program in the Western Region in the last 35 years (the lynx was released alive from a foothold trap in Idaho). Should USFWS determine that placement of radio collars or other actions to facilitate research are warranted for captured lynx, WS-Utah will cooperate with USFWS and UDWR and follow the necessary protocol. Thus far, WS-Utah has not had an incidental take in Utah. It is most likely that a lynx captured in Utah will be dispersals from the reintroduced population in Colorado (these would likely be lost to the population unless they returned to Colorado) or possibly in the Uinta Mountains (primarily in the Ashley and Wasatch-Cache National Forests) from dispersals from northern areas. By implementing the above policy, we believe the risk to lynx of incidental take will be minimized, and therefore, all WS-Utah activities *may effect, but*

23 Occupied habitat is where a species or its sign is found, which is typically associated with a particular habitat type. However, sometimes lynx sometimes travel outside typical habitat, especially during dispersal.

not likely to adversely affect potential lynx populations in Utah (April 2017 USFWS Biological Opinion).

Utah Prairie Dog: *Threatened (49 FR 22330, June 14, 1991) with Special Rule for Regulated Taking (56 FR 27438, June 14, 1991) without critical habitat*

Utah prairie dogs are found throughout central and southern Utah (UDWR 2015, USFWS 2010). Two other species of prairie dogs occur in Utah, the Gunnison (*C. gunnisoni*) and white-tailed (*C. leucurus*) prairie dogs. Utah prairie dogs can be distinguished from them by their cinnamon to clay coloration of the dorsum and the proximal half of the tail. They have sharply outlined black eyebrows which are lacking in the other species (Pizzimenti and Collier 1975).

The Utah prairie dog can do significant damage to farms by digging holes and eating crops. As a result, they have been poisoned, which has been a factor for their decline. Land development, deteriorating rangeland health, the encroachment of woody vegetation, sylvatic plague, and drought are also contributing factors. Conservation efforts have included encouraging landowners, including agencies, to improve the health of rangelands and compensating farmers that set acreage aside for the prairie dogs.

WS-Utah uses several methods that have the potential to lethally and nonlethally impact Utah prairie dogs including pyrotechnics, foothold traps, cage traps, snares, quick-kill traps, gas cartridges, aluminum phosphide, rodenticides (e.g. such as zinc phosphide). When and if these methods are used in occupied habitat, then WS-Utah will consult with the UDWR and follow pesticide labels.

Pyrotechnics are used at airfields and agricultural areas, primarily against birds to protect people/aircraft and crops. It is anticipated that noise from these devices could scare them, but it is anticipated that it would have no more than a temporary effect on them. To minimize the effect of noise on prairie dogs, WS-Utah will not use pyrotechnics within a quarter mile from occupied Utah prairie dog habitat, unless in an emergency response protecting human health and safety on an airport. Emergencies are not covered by this programmatic consultation and would be consulted on separately "after the fact".

Capture methods such as traps and snares, would not be used in occupied prairie dog habitat. To eliminate any potential impacts, foothold traps and foot snares will be equipped with pan-tension devices or integral pan-tension to preclude prairie dogs from becoming caught. Pan-tension set at 5.5-6 lbs. precludes accidental capture of prairie dogs. Pan-tension set between 4-5lbs will almost eliminate the risk of nontarget capture of smaller mammals (red fox, swift fox, kit fox etc.) 92-100% of the time (Andelt 2003). Pan-tension set over 6 lbs. precludes the take of most targeted predators (Turkowski et al. 1984). Pan-tension is always used when trapping near prairie dog towns, including white-tailed or Gunnison's prairie dog towns as well. If neck snares are used adjacent to prairie dog towns, WS-Utah will incorporate stops that do not allow prairie dogs to close the noose tight enough to capture them.

No impacts to Utah prairie have occurred by WS-Utah through the use of gas cartridges. Gas cartridges, by their use restrictions and design, target only coyotes, red fox and striped skunks at

their den/burrow sites. WS-Utah employees are trained in the identification and sign of Utah prairie dogs; therefore, no Utah prairie dog burrows would be targeted. Utah prairie dogs are also highly unlikely to be using active dens of coyotes and red fox.
Gas cartridges, when used for PDM near Utah prairie dog habitat, are most likely beneficial to the species. By removing predators that prey upon prairie dogs, the use of gas cartridges help limit the effects of predation on localized prairie populations. Given that WS'-Utah use of gas cartridges targets coyotes, red fox and striped skunks, and that WS-Utah complies with all label restrictions, there is a discountable likelihood that Utah prairie dog will be adversely affected by the use of gas cartridges. WS-Utah concludes the use of gas cartridges results in a "may beneficially affect" finding for Utah prairie dogs by removing predators that prey upon prairie dogs.

Ground shooting is used in conjunction with calling, stalking and night vision. Ground shooting would have no direct lethal effect on Utah prairie dog's because positive target species identification is made before an animal is removed. Thus, WS'-Utah use of ground shooting has been and is expected to be virtually 100% selective for target species, and would not pose any lethal risk to Utah prairie dogs. Gunshot noise may temporarily disturb Utah prairie dogs, but they are most likely conditioned throughout the year to the sound of gunshot noise from general hunting activities and it is unlikely the disturbance would be life threatening. Ground shooting may remove predators that prey on Utah prairie dogs resulting in a "may beneficially affect" finding by reducing potential predation on their limited populations.

WS-Utah uses several chemical toxicants. Several rodenticides are used by WS-Utah. WS-Utah will not use any of the rodenticides, as required by labels, in Utah prairie dog colonies.

Other PDM conducted adjacent to active prairie dog towns could enhance prairie dog populations. This would be an unintentional benefit for a prairie dog population where the action was being conducted to protect another resource such as livestock. However, if predation was identified as having an impact on a particular population and WS-Utah targeted predators to protect the prairie dog, that action would likely be requested by USFWS and conducted under a different consultation. Additionally, WS uses an insecticide to reduce plague (*Yersinia pestis*) carrying fleas (Order Siphonaptera) in white-tailed prairie dog colonies to protect black-footed ferrets which could be also used in Utah prairie dog towns where a plague outbreak occurs to protect them. Plague tends to kill off most prairie dogs in a colony. An oral plague vaccine is under development which is effective but needs to be registered through the Food and Drug Administration. Once registered it is possible that this would be used, but this may take several years before it is available. These actions, where the target species are predators or fleas, would be beneficial for the Utah prairie dogs but done under a request most likely from USFWS. Thus, WS-Utah could only have an unintentional potential beneficial effect where predator control was being conducted to protect a different resource.

WS-Utah concludes that our proposed action *may effect, but is not likely to adversely affect* the Utah prairie dog based on the determination in the (April 2017 USFWS Biological Opinion) and the measures taken to minimize the potential to affect Utah prairie dogs, as discussed above.

California Condor ***Endangered*** *(32 FR 4001, March 11, 1967) with critical habitat in California (41 FR 187, September 24, 1976), NEP designated for Southwest reintroduction (61 FR 54044, October 16, 1996)*

The condor is the largest flying land bird in North America. They are classified as New World vultures, which, unlike Old World vultures, find food items by sight and not smell. They are a long-lived species that mature and reproduce slowly. A NEP of California condors was established at Vermillion Cliffs in northern Arizona. The designated condor experimental area is located in Arizona, Utah, and Nevada, and is bounded on the southern border by Interstate 40, north by Interstate 70, east by Arizona and Utah Highway 191, and west by Interstate 15.

At the 5 year review of this reintroduction program, 47 condors had been released. Of those 47, 18 birds died and four were returned to captivity. After 5 years, there were 25 free-flying condors northern Arizona. In March 2001, a reintroduced bird produced the first confirmed condor egg laid in the wild since 1986. Management of the reintroduced population is governed by the October 16, 1996 Final Rule. This rule allows for unavoidable and unintentional take of California condors when such take is incidental to a legal activity such as hunting, driving, or recreational activities and does not result from negligence. The final rulemaking further applies this standard to construction activities, road building and farming and stated that lawful activities on private land should not be restricted. It is this flexibility in an experimental designation that will contribute to the long-term conservation of condors.

Members of the NEP not occurring within the NWR or NPS System are treated as proposed species under Section 4 of the Endangered Species Act of 1973 for the purpose of Section 7. Consultation/conferencing is not required for proposed species unless a federal agency determines that its action is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. However, outside the NEP zone in Utah, they are treated as endangered until they are returned to the NEP or the NEP area is expanded.

Three condors wandered from the NEP to Grand Junction, Colorado in 1998, but did not stay and returned to the NEP (USFWS 2001). Another condor in April 2015, a two year old, travelled to Mesa Verde National Park and then Los Alamos, New Mexico. It is unknown whether it will return to the NEP. As a result of the 3 condors that traveled to Colorado, M-44s were not used in a 5 mile corridor around Colorado and San Juan Rivers in Colorado and the Green River in Utah from March 1 to October 1. Since this has not been a regular occurrence and occurred shortly after their release, it is expected that this will rarely occur. While it was expected that the released birds would remain within the delineated experimental boundary, the potential for condor movement outside the experimental area had to be considered. The resultant potential impact for impact by WS-Utah damage management activities in the areas surrounding the release site was the impetus for a law suit brought against WS-Utah to restrict the use of M-44s in those areas outside the experimental boundary with the potential for condor occurrence. Information provided by the Peregrine Fund during the legal proceedings, identified habitat as the areas within Arizona, Utah, and Nevada with the potential to attract condors. Additional information concluded that when the birds did move out of the release area, they were more likely to travel along these riparian corridors during the summer months.

WS-Utah (2006b) conferenced with USFWS (2006b) on condors. It was agreed that WS-Utah would continue to provide services to protect livestock, wildlife, property and human health and safety, from damage caused by predators. In providing these services WS-Utah utilizes a variety of damage management methods and strategies.

- Currently WS-Utah is not using M-44's within USFWS condor habitat as noted in the U.S. Pacific Southwest Condor Region Review of 2013, and WS-Utah does not have any immediate of forseeable plans to use M-44's within this area. All M-44 use will be north of I-70. In addition WS-Utah will not set M-44 with the establish five mile corridor of the Green and Colorado Rivers, and abide by all EPA label requirements for M-44's, which specifically prohibits its use in National Parks and National Monuments (including Grand Canyon NP and the Grand Staircase/Escalante, Prashant and Vermillion Cliffs National Monuments) except for the protection of endangered species. Use is also prohibited in areas specifically set aside for recreation such and the Glen Canyon and Flaming Gorge Recreation Areas.

- Aerial gunning is a species specific method of damage management control that is virtually 100% effective in targeting a species and would not pose a direct take threat to condors. However, condors could be susceptible to lead shot remaining in carcasses if nontoxic shot were not used, therefore WS-Utah will use non-toxic shot in areas occupied by condors. Ground shooting is also specific to individual predators but lead fragments may remain in carcasses left available to predators, therefore carcasses with possibly lead fragments are retrieved and made unavailable to condors (buried, removed from the field, etc.).

To reduce the potential for adverse effects to condors, WS'-Utah has and proposes to continue to limit use of the M-44 device to protect condors. WS-Utah will restrict M-44's to single sets no closer than 1,000 feet from one another and they will not protrude above ground and shall be covered so that are not visible. Restrictions are in place in areas outside of the experimental, non-essential boundary but within the riparian corridors of the Colorado, Green, and San Juan Rivers (and extending 5 miles on either side of the river) between March 1 and October 31 and in areas within the boundary when condors are present. Additionally, when conducting WDM anywhere where condors may encounter our methods or carcasses of animals taken by our program, WS-Utah:

1. Will use only nontoxic shot for any damage management aerial gunning activities in the condor NEP and in condor habitat within Washington and Iron counties.

2. Will continue to monitor project areas for the presence of condors.

3. Whenever practical, WS-Utah will recover coyote carcasses from ground shooting efforts to make those carcasses unavailable to condors.

4. Annually coordinate with land management agencies to reduce the likelihood of impacts when WDM projects occur inside riparian/cliff corridors.

Evidence has found that many terrestrial raptors (including California condors), are impacted from lead toxicity as a result of ingesting lead shot and bullet fragments from carcasses and gut piles (Cade 2007, Fisher et al. 2006). As a result of this finding, WS has been working towards the use of nontoxic shot (bismuth, steel, tungsten, nickel, and combinations thereof) nationally in aerial hunting, and nontoxic bullets (copper) for ground-based shooting. Research into the toxicity of nontoxic shot to birds is limited, but so far ingestion of nontoxic shot does not appear to adversely affect birds (Brewer et al. 2003, Ringelman et al. 1993). It has been standard WS operating procedure to retrieve carcasses shot with lead bullets and shot as an acceptable way to minimize lead exposure, thus minimizing the potential risk to raptors, which would be beneficial for condors found in Utah.

On the other hand, WDM could have a positive effect on the California condor. Coyotes were responsible for the depredation of at least 3 condors in Arizona between 1996 and 2002 (Cade et al. 2004), and management targeting coyotes could be considered beneficial for them if it has been conducted in an area where they come into the State. Thus, WDM is likely to have a potential beneficial effect on the condor.

WS-Utah will remain in contact with USFWS, UDWR and the Peregrine Fund regarding the known locations of condors outside the Experimental Area. Should a condor leave the Experimental Area, WS-Utah will implement the RPAs for endangered condors. Because WS-Utah implements all of the measures discussed above, we conclude that our proposed action "***may effect but not likely to adversely affect***" the California condor outside of the 10j boundary and is ***not likely to jeopardize the existence*** of the California condor within the 10j boundary (April 2017 USFWS Biological Opinion).

Gunnison Sage-Grouse: *Threatened (79 FR 69191, Nov. 20, 2014) with critical habitat (79 FR 69311, Nov. 20, 2014)*

Gunnison sage-grouse depend on a variety of shrub-steppe habitats throughout their life cycle and are closely associated with sagebrush habitats. The Gunnison's sage-grouse can be found in a variety of habitats, but tend to favor sagebrush and grasslands in eight isolated areas of southwestern Colorado and two in Utah. In Utah, two populations exist that are associated with the Monticello-Dove Creek population. In addition, the Pinion Mesa population is found along the border of east central Utah, but primarily found in Colorado. Decline in this species has primarily been as a result of the loss of habitat and habitat fragmentation, predation and disease (specifically West Nile virus). Another potential limiting factor has been cited to be the alteration (habitat destruction) of and disruption at leks. Lek sites, sites where grouse congregate during the breeding season, are an important area for these species. Leks are located a gently sloping or flat areas located on bare soil, wind-swept ridges, exposed knolls, low sagebrush, meadows, and other relatively open sites with good visibility and low vegetation structure. Leks are often surrounded by dense cover, used for escape, and thermal and feeding cover. Leks can be formed opportunistically at any appropriate site within or adjacent to nesting habitat at any time, but are mostly historic sites. Lek habitat availability is not considered to be a limiting factor for sage-grouse in Utah.

Few WS-Utah WDM activities have the potential to adversely affect grouse populations. Foothold traps for smaller predators are used exceedingly rare in Utah and will only be used in grouse areas where the grouse will not have access to it. Larger foothold traps used for coyotes will have pan-tension devices in use that will preclude the capture of grouse (> 5 lbs. pressure which precludes capture of sage-grouse). Rodenticides used for prairie dogs and ground squirrels could be a primary hazard for grouse. However, coloration of the rodenticides, primarily zinc phosphide (dark green to black) minimizes the potential for grouse to take the bait. Additionally, the label requires applicators to place the bait in active burrows, thereby minimizing the potential for grouse to take the bait. Thus, it is anticipated that the use of rodenticides in Utah will have no effect on grouse populations. Additionally, rodenticides were not used in Gunnison sage-grouse habitat from FY10 to FY14.

Aerial hunting is probably the most common method used in grouse habitat of all of the thus far mentioned. Aerial hunting could disrupt breeding behavior at a lek. To minimize potential impacts, WS-Utah will avoid historical leks with aircraft by a quarter mile or more or where a new one is discovered. WS-Utah will discuss the locations of leks with USFWS and will notify USFWS if a new one is located. WS-Utah will stay away from leks 1 hour before sunrise to 3 hours after sunrise from April 1 to May15. If a coyote is seen in the lek area, it can be pursued because it will have already disrupted the lek. WS-Utah concludes that it ***may affect but not likely to adversely affect***, but is not likely to adversely affect Gunnison sage-grouse, but more likely to have a beneficial effect on them (April 2017 USFWS Biological Opinion).

Western Yellow-billed Cuckoo (Western U.S. Distinct Population Segment): *Threatened (79 FR 59991, Oct. 3, 2014) with critical habitat (79 FT 67154, Nov. 12, 2014)*

The western yellow-billed cuckoo inhabits scattered riparian areas throughout north eastern Utah. It is found in several lowland riparian areas where it lives in dense willow and cottonwood (*Populus* spp.) forested tracts. It is primarily an insectivorous bird, often foraging high in the canopy of cottonwoods on caterpillars, and will also sometimes take small vertebrates. Their nests are primarily found in nearby willows. Loss of both forested riparian habitat for nesting and tropical wintering habitat has been cited as the primary reason for its decline (Ehrlich et al. 1988). WS-Utah conducts minimal WDM activities in the habitat where this species could be found.

Ground shooting is used in conjunction with calling, stalking, and night vision and is used for the removal of coyotes, red fox and badgers in areas that may be occupied by yellow-billed cuckoo. Shooting would have no direct lethal effect on yellow-billed cuckoo because positive target species identification is made before an animal is removed. Thus, WS'-Utah use of ground shooting has been and is expected to be virtually 100% selective for target species, and would not pose a significant lethal risk to yellow-billed cuckoo. Gunshot noise may disturb yellow-billed cuckoo, but the effects are likely to be insignificant and discountable as activity will not occur in suitable habitat during the cuckoo nesting season, June 1 – August 31. Shooting, when used for WDM activities targeting beaver in occupied yellow-billed cuckoo habitat, is most likely beneficial to the species. By removing beaver that damage yellow-billed cuckoo habitat, shooting helps limit the effects of beaver resulting in a "may beneficially affect" finding for localized yellow-billed cuckoo populations.

WS-Utah may use 4-wheel drive vehicles, ATVs, motorcycles, snow machines, aircraft or riding horses in occupied yellow-billed cuckoo habitat. While conducting WDM activities WS-Utah may inadvertently disturb a yellow-billed cuckoo. Activities would not be directed at yellow-billed cuckoos, would be of temporary nature, and yellow-billed cuckoos would most likely not abandon an established territory. All WS-Utah site access activities would be in compliance with all Federal, State and local laws, as well as in compliance with the terms and conditions set forth in WS-Utah MOUs with land management agencies.

Given that WS'-Utah access to occupied yellow-billed cuckoo habitat for WDM activities is only on an as-needed basis; WS-Utah adheres to all Federal, State and local laws; WS-Utah adheres to rules set forth in cooperative MOUs with land management agencies; WS-Utah activities are not likely to have long-lasting effects on localized yellow-billed cuckoo populations; and limited disturbances from site access activities would be insignificant, WS-Utah concludes that site access for WDM activities results in a "**may affect, not likely to adversely affect**" finding for yellow-billed cuckoos (April 2017 USFWS Biological Opinion).

BDM involving hazing birds from airfields or crops is an activity that may affect the yellow-billed cuckoo. Thus, WS-Utah will refrain from using pyrotechnics and other hazing devices within a quarter mile of proposed or designated critical habitat for the cuckoo (outside of airport properties were BDM occurs for human health and safety) from mid-April through mid-October, the time they are in Utah (Hughes 1999), to avoid harassment of cuckoos. With the standard operating procedure limiting hazing in BDM to a quarter mile from proposed or designated critical habitat from late April thru September. WS-Utah concludes that WDM activities "***may affect, not likely to adversely affect***" cuckoos as the potential is discountable with the minimizing measures in place or potentially beneficial.

Yellow-billed Cuckoo Conservation Measures

- Where activity may be proposed within a 0.5 mile of riparian areas with perennial water flow, WS-Utah will:
  - Avoid activity between June 1 – August 31 (cuckoo nesting season); or,
  - Assess riparian areas for suitable cuckoo habitat using the Utah Field Office's 2015 Guidelines for the Identification of suitable habitat for WYBCU in Utah https://www.fws.gov/utahfieldoffice/Documents/June%202015_Guidelines%20for%20the%20Identification%20of%20Suitable%20Habitat%20for%20WYBCU%20in%20Utah.pdf. Where suitable habitat exists, activity will be avoided between June 1 – August 31.
- Where activity may be proposed within a 0.5 mile of critical habitat, WS-Utah will avoid activity between June 1 through August 31.

- Within a 0.5 mile of suitable habitat, and during the nesting season (June 1 – August 31), WS-Utah personnel will not use pyrotechnics or other noise-making devices.

- Within a 0.5 mile of critical habitat, and during the nesting season (June 1 – August 31), WS-Utah personnel will not use pyrotechnics or other noise-making d**evices.**

Mexican Spotted Owl: *Threatened (58 FR 14248, March 16, 1993) with critical habitat (69 FR 53182, August 31, 2004)*

On the Colorado plateau, Mexican spotted owls tend to select narrow, steep-walled canyons as preferred nesting and roosting sites. They often nest within canyon walls in small clefts, cracks, and depressions and make use of the canyons and adjacent uplands as foraging habitat. Threats to the species and its habitat include recreation, grazing, road improvement and development within canyons, and loss or fragmentation of habitat from fires and timber harvest within uplands. WDM methods used by WS-Utah are not likely to impact this species because they are not typically used in the steep-walled canyon habitats inhabited by the owl. WS-Utah WDM activities rarely take place in steep-walled canyon habitat because wildlife responsible for damage typically are not found in this habitat. WS-Utah has not used rodenticides in spotted owl habitat (steeped walled canyons or the upland habitat surrounding them) and does not anticipate using them in Mexican spotted owl habitat in the future. The risk of take with foothold traps is nullified by using pan-tension devices and not setting traps in spotted owl habitat (typically these areas are not conducive for taking target wildlife). Therefore, WS-Utah concludes that WDM activities (the use of rodenticides) ***may affect, not likely to adversely affect*** spotted owls (April 2017 USFWS Biological Opinion).

Southwestern Willow Flycatcher: *Endangered (60 FR 10694, February 27, 1995) with critical habitat (50 CFR 60886, October 19, 2005)*

This flycatcher occurs in riparian habitats with dense vegetation such as willows (*Salix spp.*), tamarisk (*Tamarix spp.*), or Russian olives (*Elaeagnus angustifolia*). It is found in southern Utah from spring through summer. This species is highly insectivorous, taking insects on the wing or gleaning them from vegetation. Several reasons have been cited for their decline including habitat degradation, water changes, fire, invasive plant encroachment, nest parasitism by cowbirds, and predation (especially nestling/egg by great-tailed grackles and possibly corvids). Southwestern willow flycatcher habitat is broken down into 29 management units throughout the southwestern United States. Three of these units fall within southern Utah; Virgin, Powell and San Juan (USFWS 2013). Given the isolated locations of these three management units, it is likely that WDM conducted by WS-Utah will have little if any affect in these areas.

WS-Utah WDM methods that have the potential for affecting the flycatcher are either related to ARDM, BDM, or FSDM. Beaver damage management projects involving the removal of established beaver dams have the potential for impacting this species. However, WS-Utah removes only recently built dams and their removal would likely be more of a benefit to this species. Recent beaver activity does have the potential to impact this species by cutting down the flycatchers' nesting trees and, thus, beaver damage management could benefit the species. The presence of WS-Utah personnel near nesting sites during ARDM or feral swine management has been discussed as a potential impact. However, WS-Utah personnel usually do not remain in any area for long periods and move on shortly after conducting WDM activities. WS-Utah believes that such encounters will have no or minimal effect on this species if WS-Utah removes few beaver in the range of the flycatcher.

BDM activities that have potential to affect flycatchers are mostly associated with harassment programs such as those at airports and agricultural fields. WS-Utah has only conducted hazing operations in response to wildlife hazards on airports. If a flycatcher were in an air an airfield, hazing would likely be beneficial since they could be struck by aircraft.

Considering the flycatcher's habitat preference (riparian area with dense growth), seasonal presence (summer vs. winter when most WDM methods are used), and diet (insectivorous), it is very unlikely that this species would be affected by any WDM method in Utah. WS-Utah conducts activities such as blackbird damage management at feedlots where species such as grackles and cowbirds could be taken which are known nest predators and could have a positive effect on the flycatcher. Therefore, WS-Utah believes that WDM ***may affect, but is not likely to adversely affect*** this species because the effects will be potentially beneficial (April 2017 USFWS Biological Opinion).

Not Likely to Jeopardize

Black-footed Ferret

USFWS, in cooperation with BLM, Colorado Parks and Wildlife, and UDWR reintroduced ferrets into northwestern Colorado and northeastern Utah. The northwestern Colorado and northeastern Utah population is designated as an NEP population in accordance with Section 10(j) of the ESA (63 FR 52823-52841). A special rule has been developed stipulating that there would be no violation of the ESA for unavoidable and unintentional take (including killing or injuring) of a reintroduced ferret, when such take is non-negligent and incidental to a legal activity (*e.g.,* PDM) and the activity is in accordance with State laws or regulations. The NEP area covers occupies portions of Rio Blanco and Moffat Counties, Colorado, Uintah and Duchesne Counties, Utah, and Sweetwater County, Wyoming.

WS-Utah has worked with UDWR and Colorado Parks and Wildlife, to provide protection for the black-footed ferrets from predators (coyotes, badgers, red fox, and feral dogs) in the Wolf Creek NEP. This protection is necessary to allow the black-footed ferrets to establish in a new environment without excessive predation. Removal of coyotes and badgers, along with alteration of perches for raptors, has benefited black-footed ferrets.

WS-Utah uses methods that will **"*not likely to jeopardize*"** the ferret such as aerial PDM and ground shooting in and around the prairie dogs, and padded-jaw foothold traps with pan-tension devices on the periphery away from the prairie dog colonies (April 2017 USFWS Biological Opinion). WS-Utah have not taken a ferret, and will continue to work with state agencies to ensure the protection of ferrets during PDM activities.

Not likely to adversely affect

Desert Tortoise: *(Mojave Population): Threatened (55 FR 12178, April 2, 1990) with critical habitat (59 FR 5820, February 8, 1994; 59 FR 9032, February 24, 1994)*

This herbivorous tortoise occurs in the creosote bush (*Larrea tridentata*), shadscale (*Atriplex* spp.), blackbush (*Colegyne ramossisma*), and Joshua tree (*Yucca brevifolia*) areas of Mojave Desert. It typically occupies basins and bajadas, and occurs on rocky slopes below 4,000 feet in elevation. It is most active in the spring and early summer when annual plants are most available for forage. The Mojave Desert tortoise in Utah is restricted to Washington County.

Washington County, where the desert tortoise is found, has few livestock operations. Historically, the area did have livestock operations and WS-Utah conducted routine winter and spring coyote control for the protection of sheep and calves. With the absence of livestock, WS-Utah no longer conducts WDM in desert tortoise habitat. WS-Utah is requested on occasion to remove individual predators which have become a public safety nuisance or have killed livestock in suburban developments. WS-Utah also has assisted in the protection of tortoises, especially predation of eggs and young by ravens, and coyotes and other predators as well. We believe there may also be opportunities to assist in the conservation of desert tortoise through the removal of feral pigs (when encountered) as they have been found along the Virgin River in Nevada and Arizona, an area in the desert tortoise range that comes into Utah. If predation becomes a serious limiting factor for tortoise, WS-Utah would gladly discuss opportunities with USFWS and other tortoise conservation groups. Future WDM will not occur in desert tortoise without consultation with the USFWS and a certified desert tortoise biologist and other conservation measures. If WDM is needed within tortoise habitat in the future, conservation measures including, but not limited to the following, will apply.

Conservation measures for desert tortoise

The following conservation measures are necessary and appropriate to minimize take of desert tortoise in the future if WDM is requested in desert tortoise habitat:

1. WS-Utah shall implement measures to minimize injury or mortality of desert tortoises due to WDM activities.

2. WS-Utah shall implement measures to minimize predation on tortoises by predators drawn to project areas.

3. WS-Utah shall implement measures to minimize negative impacts to desert tortoise habitat, such as washing vehicles when entering occupied habitat, traveling on designated routes while in occupied habitat to avoid soil compaction, erosion, or crushed vegetation, while conducting WDM activities.

4. WS-Utah will consult with a certified desert tortoise biologist prior to conducting WDM.

5. A maximum speed limit of 20 miles per hour shall be required for all vehicles on unpaved secondary roads and 15 miles per hour on unimproved roads.

6. The agency requesting WDM activities shall be responsible for providing an authorized desert tortoise biologist for the tortoise education program and clearing vehicle routes of tortoises. In addition, the agency shall provide appropriate information to WS-Utah personnel on the occurrence of desert tortoises in project areas.

7. WS-Utah personnel shall be instructed to check under vehicles for tortoises seeking temporary shelter prior to activating the vehicle during the tortoise active season, from March 1 through October 31.

8. WS-Utah shall implement a litter-control program that will include the use of covered, raven-proof trash receptacles; removal of trash from project sites to the trash receptacles following completion of program activities; removal and appropriate disposal off-site of retrievable animal carcasses resulting from WDM activities.

9. All WS vehicles including ATVs shall stay on designated roads or trails that have been cleared of tortoises by an authorized desert tortoise biologist. Cross-country vehicle travel is prohibited. Overnight parking and storage of quipmentand materials shall be in previously disturbed areas (i.e., lacking vegetation).

We believe that WS-Utah will ***not likely to adversely affect*** the continued existence of this species (April 2017 USFWS Biological Opinion).

Desert tortoise may be adversely affected by the indiscriminant use of fumigants. However, no PDM activity occurs within occupied desert tortoise habitat in Utah and WS-Utah employees are trained in the use of fumigants to preclude their use in tortoise dens. Off-road travel is restricted within tortoise habitat to preclude adverse effects from vehicle burrow collapse.

Virgin River Chub *(Endangered (54 FR 35305, August 24, 1990) with critical habitat (65 FR 4140, January 26, 2000)):*

This fish is a medium-sized silvery minnow reaching 18 inches in length. In Utah, it is found in the Virgin River, where it prefers deeper areas with swift current and boulders or other forms of cover. Threats include habitat degradation in the form of water developments and diversions, disease, and competition with invasive species. This species would benefit from nonnative species removal, including feral swine since a population exists along the Virgin River in Arizona where they are actively removing them, and potentially in Utah. WS-Utah would consult further with USFWS if WS-Utah undertook invasive aquatic species removal. Thus, if WS-Utah conducts PDM on the Utah side of the Virgin River, those WDM activities will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Woundfin *(Endangered (35 FR 16047, October 13, 1970) with critical habitat (65 FR 4140, January 26, 2000)):*

This is a small silvery minnow inhabiting shallow, turbid, fast-flowing water. The woundfin once occurred throughout the Lower Colorado River Basin, but currently is only found in the Virgin River in south western Utah, similar to the Virgin River chub. Reasons for its decline include habitat degradation in the form of water developments and diversions and competition with invasive species. This species would benefit from nonnative species removal, including feral swine since a population exists along the Virgin River in Arizona where they are attempting to eradicate them, and potentially in Utah. WS-Utah would consult further with USFWS if WS undertook invasive aquatic species removal. Thus, if WS-Utah conducts feral swine removal work on the Utah side of the Virgin River, those WDM activities will ***not likely to adversely affect*** this species, but will likely have a beneficially effect (April 2017 USFWS Biological Opinion).

T&E Fish Species Conservation Measures

- In advance of a project involving invasive aquatic species removal, WS-Utah personnel will consult USFWS at the site-specific level.

- In advance of any dam removal projects in proposed or designated critical habitat of any T&E and Candidate fish species, WS-Utah will consult with USFWS on the project.

Shivwits Milk-Vetch *(Endangered (71 FR 43514, September 28, 2001)) with critical habitat (71 FR 77972, December 27, 2006)):*

Shivwits milk-vetch is a perennial herb in the bean family, with yellow-white flowers that bloom from late April to early June. Shivwits milk-vetch grows on clay soils of Chinle Shale in warm desert shrub and pinyon-pine[24] communities. This species is endemic to Washington County, Utah. Threats to its habitat include human development and grazing from livestock and native wildlife. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, ORV activities are typically very minimal and always confined to established roads and trails on federal and private lands where feasible. In addition, WS-Utah has conducted minimal WDM activities in that area. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Jones Cycladenia *(Threatened (51 FR 16530, May 5, 1986) without critical habitat):*

This species is a long-lived perennial herb found in plant communities of mixed desert scrub, juniper, or wild buckwheat (*Erigonum* spp.)-Mormon tea (*Ephedra* spp.) between 4,000-6,000 feet in elevation. In Utah it's found in the canyonlands region in areas with gypsiferous, saline soils and all are on National Park Service, BLM, Tribal, and State lands in Emery, Garfield, and Grand Counties (no longer in Kane County). It is also found in Arizona in Mojave County. This species is vulnerable because of the small number of known populations and because the arid climate and harsh soils make this ecosystem slow to recover from surface disturbance. Ongoing and potential anthropogenic impacts to habitat include ORV use, oil, gas, and mineral exploration, including uranium mining and tar sands, and livestock grazing (although the rule

24 Two needle (*Pinus edulis*) and single-leaf (*P. monophylla*) pinyon pines and Utah juniper (*Juniperus osteosperma*).

notes the probability of grazing causing serious damage has been minor). Since listing, a number of other biological limiting factors have come to light. Research, as reported in USFWS (2008) showed that the plant has, at best, low fruit production and seed set, likely due to a complicated pollination system and inadequate pollinator abundance (i.e., pollinators may have been lost or may be migratory and appear episodically). As a result of this, no seedling germination events have been documented. In addition, because of the small populations, the cycladenia may face genetic vulnerability with its fractured distribution further complicating issues associated with limited natural reproduction, dispersal constraints, and genetic risks. Threats include ORV traffic, and mineral and energy exploration and development. Some WS personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, off-road activities are typically very minimal and do not occur off designates trails and routes on federal lands, especially in the areas where this species is found, therefore WDM does not affect plants. In addition, WS-Utah has conducted minimal WDM activities in that area. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

San Rafael Cactus *(Endangered (52 FR 34914, September 16, 1987) without critical habitat):*

San Rafael cactus is found in Emery County, Utah. San Rafael cactus is found in fine textured soils rich in calcium derived from the Carmel Formation and the Sinbad Member of the Moenkopi Formation with most of the population on BLM lands. Threats to the habitat of this species include illegal collecting, surface disturbance from ORV use, trampling by humans and livestock, mineral resource explorations and development, insect parasitism including the cactus borer beetle (*Moneilema semipunctatum*), natural herbivory, and extended drought. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, off-road activities are typically very minimal and are confined to designated trails and routs on federal lands and private lands where feasible. In addition, WS-Utah has conducted minimal WDM activities in that area. WS-Utah concludes that WDM will have ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Winkler Cactus *(Threatened (45 FR 82480, December 15, 1980) without critical habitat):*
Winkler pincushion-cactus occurs in Emery and Wayne Counties, Utah. Winkler pincushion-cactus is found in fine textured soils derived from the Dakota Formation and the Brushy Basin Member of the Morrison Formation. It occurs in salt desert shrub communities, at elevations ranging from 4,900 feet to 6,600 feet on BLM and National Park Service lands. Threats to this species include illegal collecting, surface disturbance from ORV use, trampling by humans and livestock, mineral resource explorations and development, insect parasitism including the cactus borer beetle (*Moneilema semipunctatum*), natural herbivory, and extended drought. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, ORV activities are typically very minimal and on federal land and private land where feasible are confined to designated roads or trails. In addition, WS-Utah has conducted minimal WDM activities in that area. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Shrubby Reed-Mustard *(Endangered (*52 FR 37416, October 6, 1987*) without critical habitat):*

Shrubby reed-mustard is a perennial herb in the mustard family. This species produces yellow to greenish yellow petals that bloom from May to June. It is found in Duchene County and Uinta County, Utah. Shrubby reed-mustard is found in xeric, shallow, fine textured soils along semi-barren, white-shale layers of the Green river Formation. It grows in mixed desert shrub and pinyon-juniper communities. Threats to this species include oil and gas development and associated activities, stone mining, and grazing. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, ORV activities are typically very minimal and are confined to established roads or developed trails on federal and private lands where feasible. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Pariette Cactus *(Threatened (77 FR 70103, September 15, 2009) without critical habitat):*

Pariette cactus is a barrel-shaped cactus that is 1-3 inches in height. Genetic studies found that the Uinta Basin hookless cactus (*Sclerocactus glaucus*) was three separate species including the Pariette Cactus (*S. brevispinus*), Uinta hookless cactus (*S. wetlandicus*), and Colorado hookless cactus (*S. glaucus*). The Pariette cactus is morphologically unique from the others because flowering adults are much smaller than either of the others. Pariette cactus has stems with typically 13 ribs that extend from the ground to the tip of the plant. Along the ribs are areoles (small, cushion-like areas) with hooked spines. It produces bell-shaped pink flowers. Pariette cactus is restricted to one population in an area located in Pariette Draw along the Duchesne-Uintah County boundary. Threats include mineral and energy development, illegal collection, recreational ORV use, and grazing. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, ORV activities are typically very minimal and are confined to established roads and trails on federal lands and private lands where feasible. In addition, WS-Utah has conducted minimal WDM activities in that area. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Uinta Basin Hookless Cactus *(Threatened (74 FR 47112, September 15, 2009) without critical habitat):*

Uinta Basin hookless cactus is a perennial herb that is egg shaped and produces pink flowers from April to late May. As discussed under Pariette cactus, this species was split into three. This species occurs in Uintah and Carbon counties, Utah. Uinta basin hookless cactus is found in xeric, fine textured soils overlain with cobbles and pebbles. Its habitat consists of salt desert shrub and pinyon-juniper communities of the Duchesne and Green River formations. Threats to its habitat include disturbance from oil and gas exploration and development, grazing, and ORV use. WDM activities conducted by WS-Utah within the range of this species primarily include aerial gunning which would have no effect on this species. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, off-road activities are confined to established roads and trails on federal lands and private lands where feasible. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Wright Fishhook Cactus *(Endangered (44 FR 58868, October 11, 1979) without critical habitat):*

Wright fishhook cactus occurs in Emery County, Sevier County, and Wayne County, Utah. A member of the cactus family, this species is a perennial herb that produces nearly-white to pink flowers from late April through May. Wright fishhook cactus is found in soils that range from clays to sandy silts to fine sands, generally in areas with developed biological soil crusts. This species grows in salt desert shrub and scattered pinyon-juniper communities, at elevations ranging from 4,300 to 6,400 feet. Threats to its habitat include disturbance from domestic livestock grazing, mineral resource development, and ORV use. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, off-road activities are confined to designated roads and trails on federal lands and private lands where feasible. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

Ute Ladies'-Tresses *(Threatened (*57 FR 2048*, Jan. 17, 1992) without critical habitat):*

Ute ladies'-tresses is a perennial, terrestrial orchid with 7 to 32-inch stems arising from tuberously thickened roots. The flowering stalk consists of few to many small white or ivory flowers clustered into a spiraling spike arrangement at the top of the stem. The species is characterized by whitish, stout flowers. It blooms, generally, from late July through August. The orchid occurs along riparian edges, gravel bars, old oxbows, high flow channels, and moist to wet meadows along perennial streams. It typically occurs in stable wetland and seepy areas associated with old landscape features within historical floodplains of major rivers, as well as in wetlands and seeps near freshwater lakes or springs. Ute ladies'-tresses ranges in elevation 4,300 ft. to 7,000 ft. Nearly all occupied sites have a high water table (usually within 5 to 18 inches) of the surface augmented by seasonal flooding, snowmelt, runoff, and irrigation. In Utah, this species occurs in Cache, Daggett, Duchesne, Garfield, Juab/Tooele, Uintah, Utah, Wasatch and Wayne counties, Utah, and is known historically from Salt Lake and Weber Counties. Threats to the Ute ladies'-tresses include groundwater pumping, water diversions, sand and gravel mining, recreation impacts, illegal collection, and invasive plants. WS-Utah concludes that WDM will ***not likely adversely affect*** this species considering where WDM would be conducted to impact them (April 2017 USFWS Biological Opinion).

Last Chance Towsendia *(Threatened (50 FR 33734, August 21, 1985) without critical habitat):*

Last Chance townsendia is a low-growing perennial herb in the sunflower family. This species has golden to yellow petals, and blooms from in late April and May. Last Chance townsendia is found in clay, clay-silt, or gravelly clay soils derived from the Mancos Formation. Found in Emery County, Sevier County, and Wayne County, Utah, this species grows in salt desert shrub and pinyon-juniper communities. Habitat loss, degradation, and fragmentation are the largest threats this species. Some WS-Utah personnel use 4-wheel ATVs or horses in remote areas to conduct WDM. However, ORV activities are typically very minimal and are confined to established roads and developed trails on federal and private lands where feasible. WS-Utah concludes that WDM will ***not likely adversely affect*** this species (April 2017 USFWS Biological Opinion).

T&E and Sensitive Plant Species Conservation Measures

- WS-Utah will not conduct beaver dam removal where T&E species occur without consulting further with USFWS.

- WS-Utah will avoid ingress and egress routes in occupied areas.

- WS-Utah personnel will not collect plants while afield.

- WS-Utah personnel will wash vehicles regularly to ensure WS-Utah does not spread invasive plant seeds.

- WS-Utah personnel that use horses on public lands will use certified weed-free hay, and will comply with USFS and BLM guidelines.

- WS-Utah who use ATVs will follow established roads and trails on federal, state and private lands where feasible.

4.4.1.3 State Sensitive Species

State sensitive species are listed in Appendix C. Predator damage management as implemented by WS-Utah would have no effect on State sensitive amphibians, reptiles (other than desert tortoise), mollusks or fish. Most species do not occur in the area of WDM projects. Minimization measures, either as a result of implementation of Section 7 restrictions on the program or as a result of SOPs are in place to protect peregrine falcons (*Falco peregrinus*), Mexican spotted owls, California condor, black-footed ferrets, Utah prairie dog, Canada lynx and desert tortoise. Some PDM may, in fact, benefit some sensitive species, such as sage-grouse by reducing nest predation, as well improve brood success or increase conservation of some listed species (50 CFR Part 17, pp. 43450-43496, July 13, 2000). WS-Utah also consults and cooperates with the UDWR and USFWS to conserve and protect listed species.

On August 8, 2007 the bald eagle was officially removed from the endangered species list since the USFWS determined that protection under the ESA was no longer warranted. However the bald eagle still remains federally protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The USFWS has developed National Bald Eagle Management Guidelines to advise Natural Resources agencies when and under what circumstances the protective provisions of these Acts may apply to their activities to help avoid violations. Bald eagles may be inadvertently taken in leg-hold traps set for other species. One such take occurred within the southern District in 1992. To avoid the potential for such take, WS-Utah does not set traps within 30 feet of exposed bait and is required to stake down the bait to preclude it being moved closer to the trap (WS Directive 2.450). Because of these policies, adverse effects to bald eagles are expected to be nonexistent.

The BLM uses the UDWR Sensitive Species list to analyze impacts of activities they propose or permit. Thus, effects to BLM sensitive species are identical to effects to State sensitive species

The Forest Service has developed a single list for all of Region 4 National Forests. A review of that list show no sensitive species (other than those already addressed above) which WS-Utah PDM activities may adversely affect. Most of the Forest Service sensitive species are plants which PDM activities would have no effect.

4.4.2 Alternative 2 – WS-Utah Operational Lethal Damage Management for Corrective PDM and Technical Asssistance

Under Alternative 2, PDM would be limited to those instances where confirmed predator damage has been documented. Likely, WS-Utah would respond with increased use of aerial PDM, and call and shoot techniques, both of which are highly selective for the offending animals. However, nontarget wildlife may be taken in producer initiatives without WS-Utah preventive PDM. Overall, impacts to nontarget wildlife populations, including T&E and sensitive species would be similar to Alternative 1.

4.4.3 Alternative 3 - Nonlethal Damage Management Only

Since WS-Utah would be restricted to nonlethal methods only, the potential to "take" a listed or sensitive species would be greatly reduced. Incidental take may still occur as a result of harassment activities, and a new consultation would be necessary for species protected by the ESA. In general, impacts to nontarget wildlife, including T&E and sensitive species would be minimized and likely identical to that described under Alternative 1.

4.4.4 Alternative 4 - Technical Assistance Only

Alternative 4 would result in no WS-Utah operational program. Thus, their adverse effects to nontarget wildlife species would be the same. No nontarget animals would be captured or harmed by WS-Utah. However, it must be considered that overall nontarget captures could increase as untrained individuals would attempt to conduct control. For the more common species, the magnitude could likely be similar to the current program. However, some T&E, or sensitive species may be inadvertently killed by these efforts, especially if the efforts include the illegal use of pesticides. While WS-Utah would still be available to advise producers under Alternative 4, compliance with WS-Utah advice would be voluntary.

Alternative 4 could result in a nontarget take greater than those under Alternative 1, which may further endanger some species. WS-Utah would still place special emphasis on protecting T&E and sensitive species under Alternative 4. In addition, no WS-Utah operational assistance would be offered.

4.5 HUMANENESS AND ETHICS OF WS-UTAH PDM

WS-Utah takes ethics and humaneness seriously. The science of wildlife biology and management, including and wildlife research, often involves directly capturing, handling, physically marking, taking samples from, and, at times, lethally removing free-ranging animals. These actions can cause stress, pain, and sometimes-inadvertent injury to the individual animals (for example, Kreeger et al. 1990, Proulx et al. 1993, Vucetich et al. 2007, Sneddon et al. 2014). All WS-Utah field personnel strive to undertake these activities as ethically and humanely as possible under field conditions.

Ethics are standards of human conduct. The management of wildlife, especially if it involves lethal actions, can elicit varied emotional reactions from people, depending somewhat on geographic location and species, and these reactions can change over time (Littin et al. 2004, Haider and Jax 2007). The degree of interaction with natural resources appears to be a factor influencing value systems regarding wildlife.

A primary concern related to human interactions with wildlife, especially when humans kill, capture, or otherwise directly interact with animals, is humaneness. Even if uninfluenced by human actions, animal populations and individual animals experience natural mortality factors from predation, accidents, weather, disease, mortality of young, habitat degradation from overuse, and malnutrition. These natural mortality events may be influenced or attenuated by human-created habitat modification and or fragmentation. Wildlife populations reproduce at greater rates than necessary to replace deaths if all individuals died from old age. Most populations fluctuate around a habitat-driven density, called the carrying capacity. Populations that approach or overshoot this density become more sensitive to many sources of mortality.

Schmidt (1989) and Bekoff (2002) define advocates of "animal rights" as those who often place priority on individual animals, ranking animal rights as morally equal to human rights. These advocates believe that animals should not be used for human benefits (such as research, food, recreational use such as hunting and trapping, being displayed in zoos, protecting livestock or even being livestock, being used for laboratory research, or protecting natural resources from wildlife damage), unless that same action is morally acceptable when applied to humans. Advocates of "animal welfare" are those who are concerned with the welfare of animals in relation to human actions involving those animals, such as the level of suffering of individual animals, while recognizing that human benefits may sometimes justify costs to animals, such as the use of animals for research or food. Advocates for animal welfare believe that humans are obligated to manage animal populations to minimize animal suffering, especially when ecological imbalances are caused by human actions (Varner 2011). As with most things, people have a range of attitudes and beliefs from one end of the spectrum to the other. Conversely, some people are highly concerned with suffering caused by predation on wildlife and domestic livestock, including horses and livestock guard animals.
What is APHIS-WS Approach to Humaneness, Ethics, and Animal Welfare

The APHIS-WS Code of Ethics (WS Directive 1.301) states that all employees, volunteers, interns, and personnel conducting official APHIS-WS duties shall adhere to the Code of Ethics, including:

- Promoting competence in the field of wildlife damage management through continual learning and professional development;
- Showing exceptionally high levels of respect for people, property, and wildlife;
- Respecting varying viewpoints regarding wildlife and wildlife damage management;
- Using the APHIS-WS Decision Model to resolve wildlife damage problems and strive to use the most selective and humane methods available, with preference given to non-lethal methods when practical and effective.

APHIS-WS believes that all professional field biologists and personnel must have the skills, experience, and expertise to select the most effective, humane, and practical strategies suitable to the needs and circumstances. Continual learning and training are critical for ensuring that the most effective tools are used, and research and testing must be implemented continuously to improve the tools available and develop new tools. APHIS-WS also considers a tool's effectiveness in meeting the need as well as the effectiveness of an employee's time and cost in implementing those tools. Factors such as weather, device selectivity and effectiveness, personnel considerations, public safety, and other factors must be considered. Selecting effective tools and methods while considering the potential to reduce the risk of suffering helps to increase the overall effectiveness and ethical approach of PDM.

Wildlife Services employees are concerned about animal welfare. APHIS-WS is aware that some members of the public believe that some PDM techniques are controversial. Wildlife professional organizations (e.g., The Association of Fish and Wildlife Agencies and The Wildlife Society) recognize that traps and snares are effective and humane for recreational and management use (AFWA 2006, TWS http://wildlife.org/wp-content/uploads/2016/04/SP_TrapsTrappingandFurbearerManagement.pdf). Training, proper equipment, policy directives, and the use of best practices in the field help ensure that these activities are conducted humanely and responsibly.

In addition, APHIS-WS and the National Wildlife Research Center (NWRC) strive to bring additional non-lethal damage management alternatives into practical use and to improve the selectivity and humaneness of management and capture devices. APHIS-WS has improved the selectivity of management devices through research and development of pan-tension devices, break-away snares, and chemical immobilization/euthanasia procedures that minimize pain.

When implementing PDM management activities, APHIS-WS evaluates all potential tools for their humaneness, effectiveness, and ability to target specific individuals as well as species, and potential impacts on human safety. APHIS-WS supports using humane, selective, and effective damage management techniques, and continues to incorporate advances into wildlife control program activities. APHIS-WS field specialists conducting wildlife damage management are highly experienced professionals, skilled in the use of management methods and committed to minimizing pain and suffering. APHIS-WS has numerous policies and directives that provide direction to staff involved in wildlife control, reinforcing safety, effectiveness, and humaneness (Section 2.4).

How are Euthanasia and Humane Killing Defined?

APHIS-WS policy and operations comply with the guidelines of the American Veterinary Medical Association (AVMA 2013), which states "... euthanasia is the act of inducing humane death in an animal" and that "...that if an animal's life is to be taken, it is done with the highest degree of respect, and with an emphasis on making the death as painless and distress free as possible". This typically involves unconsciousness followed by cardiac or respiratory arrest, leading to loss of brain function, with minimized stress and discomfort prior to the animal losing consciousness.

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." In other words, the AVMA distinguishes between euthanasia, typically conducted on a restrained animal, and methods that are more accurately characterized as humane killing of unrestrained animals under field conditions.

Furthermore, classification of a given method as a means of euthanasia or humane killing may vary by circumstances and species. These acknowledgments are not intended to condone a lower standard for the humane euthanasia 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. AVMA (2013) states that in field cases where sophisticated equipment is not available, the only practical means of killing an animal may be using a lethal method of trapping or, if the animal is captured, still alive, and cannot or should not be released, or is unrestrained in the wild, a killing gunshot. The AVMA (2013) states that personnel should be proficient, using the proper firearm, ammunition, and trap for the species.

AVMA (2013) notes, "…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. 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."

As described by the AVMA, there may be a distinction between clinical euthanasia and field practices for humane killing but it is still considered an acceptable form of euthanasia. APHIS-WS policy and operating procedures fully comply with these guidelines, and APHIS-WS recognizes the importance of careful decision making in the field regarding all use of lethal methods.

How are Pain and Suffering Evaluated?

Animal suffering is often considered in terms of physical pain, physiological and emotional stress, and tissue, bone, and tooth damage that can reduce future survivability and health (Sneddon 2014). Injury to an animal caused by trapping can range from losing a claw, breaking a tooth, tissue damage, and wounds, to bone fractures and death (Olsen et al. 1986, Onderka et al. 1990, Phillips et al. 1996, Engemann et al. 1997, International Organization for Standardizations (ISO) 10990-5 Annex C 1999). However, the conditions of physical trauma, such as the location of the wound, whether the animal is young, old, with young, female or male, can affect the long-term fecundity and survival when released (Iossa et al. 2007).

Because we cannot directly ask an animal about its pain, and even humans have different pain thresholds and have difficulty communicating a particular level of pain, it is difficult to quantify the nebulous concept of pain and suffering (Putnam 1995). Kreeger et al. (1990) found that the physiological and hormonal stress indicators in trapped red fox occurred during the first two hours of capture. The authors assumed that these indicators were caused by anxiety, pain, fear, physical exertion, either individually or in combination. After two hours of capture, in which the animal was in "fight or flight" stress reaction, bouts of struggle became intermittent, resulting in a "conservation/withdrawal" reaction in which the animal was in a calmer state. The authors also found that padded traps caused less physical and physiological trauma than unpadded traps when traps were checked between four and eight hours after setting.

Although humans cannot be fully certain that animals can experience pain-like states, assuming that animals can suffer pain ensures that we take appropriate steps to minimize that risk and treat the animal with respect (Kreeger et al. 1990, Iossa et al. 2007, Sneddon 2014).

It is unfortunate that dependent young may occasionally be orphaned during PDM activities, but to keep things in perspective, it is important to consider the amount of suffering and death that occurs in the absence of predator removal as well. Predators by definition kill and eat prey, which does not ordinarily represent a problem unless this behavior conflicts with human interests. But regardless of whether predation creates conflicts with human interests, prey species are typically subjected to pain and suffering when preyed upon by predators. Death in nature is notoriously harsh (Howard 1986) and it would be purely speculative to infer whether the fate of any potentially orphaned predators would be any more or less harsh if their parents had not been killed through predator control activities. To the extent that predator control removes animals that would otherwise continue to kill or injure prey animals, the overall level of pain and suffering may be reduced.

How are the Humaneness and Effectiveness of Capture Methods Evaluated?

Several researchers and organizations have attempted to develop objective, comparable, and statistically relevant methods for evaluating traumatic damage and stress in captured animals (Olsen et al. 1986, Onderka et al. 1990, Phillips et al. 1996, Engemann et al. 1997, International Organization for Standardizations (ISO) 10990-5 Annex C 1999). These systems provide points for various types of physical trauma, with those points summed for total scores. One or more experienced veterinarians typically conduct scoring of each sample, and the summed scores compared among the veterinarians for the trap type. The concern with scoring methods is that results may be subjective and dependent on the evaluators, and may not be directly comparable among studies (Onderka et al. 1990, Engemann et al. 1997), nor do they include behavioral and physiological responses (Powell and Proulx 2003). Total scores also do not reflect the incremental contribution of individual scores. However, these systems can provide a systematic method for evaluating animal welfare that can be readily compared within a particular study.

In 1991, with the encouragement of animal rights and welfare groups, the European Union (then the European Economic Community) promulgated a trade regulation banning fur imports from countries deemed to be using inhumane traps for recreational fur harvest. This ban was subsequently modified to permit imports from countries using traps that have been evaluated according to international standards for humaneness. The major fur-exporting countries (Canada, Russia, and the United States) developed these standards, and Canada, Russia, and the EU subsequently signed the 2008 Agreement on International Humane Trapping Standards (AIHTS). The US did not sign the agreement because the primary authority for managing furbearing animals rests with the states and tribes, not the federal government. However, The US cooperated with the Association of Fish and Wildlife Agencies (AFWA), which represents state wildlife management agencies, to meet the intent of the agreement to improve animal welfare in US trapping and to avoid the EU trade ban. In 1997, the US and EU signed the "Agreed Minute" which gave the US the option of either banning foothold traps or adopting internationally agreed humane trapping standards. The US stated its good-faith intent to encourage and support the study, research, testing, and monitoring of the use and application of humane traps for 23 species of furbearing animals.

The US, led by AFWA as the representative for state wildlife agencies, has a test program for evaluating trap humaneness and effectiveness using five performance criteria: animal welfare, efficiency, selectivity, practicality, and safety to the user. AFWA's overarching goal regarding recreational trapping is to maintain the regulated use of trapping as a safe, efficient, and acceptable means of managing and harvesting wildlife for the benefits it provides to the public, while improving the welfare of trapped animals (AFWA 2006). This program has resulted in species-specific best management practices (BMPs) for use by recreational trappers for selecting traps and trapping practices considered to be effective and humane (http://jjcdev.com/~fishwild/?section=best_management_practices). These BMPs are updated as new information, traps, and practices are developed, with the most recent BMPs updated in 2016. The resulting information is provided to state and federal wildlife agencies, trapper associations, and state agency trapper education programs through workshops, internet, and interactive CDs. These testing and outreach programs have included funding from the USDA, the International Fur Trade Federation, and state wildlife management agencies. AFWA has tested and approved a variety of commercially-available trap types and trapping practices that meet or exceed BMP standards and guidelines, and the AFWA recognizes that it is likely that additional traps may exist that have not yet been tested (AFWA 2006).

The Furbearer Conservation Technical Working Group of the AFWA has developed BMPs for each species (http://fishwildlife.org/?section=best_management_practices). The BMPs are based on the most extensive study of animal traps ever conducted in the US, and scientific research and professional experience regarding currently available traps and trapping technologies. Trapping BMPs identify both techniques and trap types that address the welfare of trapped animals and allow for the efficient, selective, safe, and practical capture of furbearers. Trapping BMPs are intended to be a practical tool for recreational trappers, wildlife biologists, and wildlife agencies interested in improved traps and trapping practices. BMPs include technical recommendations from expert trappers and biologists, as well as a list of specifications of traps and/or trap types that meet or exceed BMP criteria. BMPs provide options, allowing for discretion and decision making in the field when trapping furbearers in various regions of the United States. They do not present a single choice that can or must be applied in all cases.

For the purpose of developing trapping BMPs, thresholds were established by the Furbearer Conservation Technical Work Group of AFWA for trap performance criteria, including humaneness. These thresholds were derived from reference standards annexed to the 1997 understanding reached between the US and the EU, with input from wildlife biologists and wildlife veterinarians. These thresholds are based on the trauma scales included in Annex C of ISO 10990-5 (1999) and include:

- **Animal Welfare:** Killing traps must cause irreversible loss of consciousness in 70% of animals within 300 seconds; user must be able to release him/herself without assistance; and forces generated by the trap should not likely cause significant human injury.
- **Efficiency:** Trap must capture and hold at least 60% of target species activating the trap (trap sprung; low likelihood of escape); non-target species captured/number of target activations <60%.
- **Selectivity:** Trap must be set and used to limit risk of capturing non-target animals while increasing chances of capturing target species (this is applied using mechanical descriptions and attributes)
- **Practicality:** The traps must be practical to use considering the following factors - cost of purchase and maintenance; ease in setting/resetting; ease of transport/storage; weight and dimensions; reliability; versatility; expected life span; need for specialized training.
- **Safety:** Use should not present a significant risk to user, and should have appropriate safety features, safety tools, or combination that can be readily applied under field trapline conditions.

The BMPs for trapping and animal release must consider:

- Setting the trap so as to prevent entanglement; minimize risk that objects or debris will prevent swivel from operating; minimize non-target capture; and minimize captured animal's exposure to domestic animals and human activities (including avoiding trails);
- Appropriately using lures, baits, and attractants so as to avoid capturing non-target animals, while complying with state law;
- Using proper pan/treadle tension to ensure selectivity for the target animal;
- Using techniques for release and euthanasia based on practices learned from a trapper education program or from experienced trappers to ensure humaneness;
- Considering factors that are specific to the species involved for selecting the location and setting the trap, including habitat, range, and biological information and options for traps and settings that meet BMP criteria.

The following BMPs are available for use in Utah for predators (as updated):

- Badger BMPs (2014): http://www.fishwildlife.org/files/Badger_BMP_2014_F.pdf
- Bobcat BMPs (2014): http://www.fishwildlife.org/files/Bobcat_BMP_2014_F.pdf
- Coyote in western US (2016): http://www.fishwildlife.org/files/Western_Coyotes_BMP_2016.pdf
- Gray fox (2014) http://www.fishwildlife.org/files/GrayFox_BMP_2014_F.pdf
- Raccoon (2014) http://www.fishwildlife.org/files/Raccoon_BMP_2014_F.pdf
- Red fox (2016) http://www.fishwildlife.org/files/Red_Fox_BMP_2016.pdf
- Striped skunk (not updated) http://www.fishwildlife.org/files/Skunk_BMP.pdf
- Weasel (not updated) http://www.fishwildlife.org/files/Weasel_BMP.pdf

Recognizing the goals of the AFWA, APHIS-WS has voluntarily agreed to assist in the development of BMPs and to abide by the BMPs developed by this program, as applicable, using the APHIS-WS Decision Model in the field. APHIS-WS recognizes that not all devices recommended in the BMP guidelines for recreational trapping used by the public meet the stringent performance requirements for use in APHIS-WS activities, particularly for efficiency, effectiveness, and durability under possibly harsh environmental conditions. To be BMP compliant, a trap must hold minimumly 60% of the animals it captures. An animal that releases itself from a trap can also become wary of traps in the future, substantially reducing the potential to recapture the animal. If, for example, WS-Utah is requested to respond to a threat to human health or safety or other damage incident where a trap is to be used, the goal would be to use a trap that would have the highest success in holding the captured target animal, while promoting efficiency and humanness of the captured animal. The need to retain the target animal, and not allow it to get away is critical to removing that target animal and thus allieviate further damage or threats to human safety.

WS Directive 2.450 (Section 2.4 A2) establishes guidelines for APHIS-WS personnel using certain types of capture devices and promotes training of its employees to improve efficiency, effectiveness, and humaneness. Additionally, all use by APHIS-WS complies with applicable federal, state, and local laws and regulations. Testing of traps and trapping systems by AFWA has continued to provide valuable information on the humaneness of traps and practices. As the information comes available, it is reviewed by APHIS-WS for its use and application in the field. Recent updates to the BMPs and forthcoming research publications indicate that there will be an increasing number of commercially available traps that meet and or exceed BMP guidelines. WS-Utah continues to use and implement BMP tools and practices as they become available and when appropriate for IWDM.

What Factors Influence Selectivity and Humaneness of Trapping?

Humaneness of trapped animals is improved by using traps types and design, and trapping practices that minimize animal injury and suffering, and increasing trap selectivity. The use of BMPs incorporates practices that include equipment specifications, the knowledge of the person using the equipment, and how the equipment is set up (with accessories) and used. Although specific traps are tested, the characteristics of the traps are identified and described as features that, either by themselves or when incorporated with other practices and the experience of the applicator, improve animal welfare and increase trappers' efficiency and selectivity.

What are the Considerations for Humaneness for Different Physical Capture Methods?

Different capture methods are discussed below. Impacts to human and pet health and safety and the environment are evaluated in Section 4.6. A humane live-capture (restraint) trap is one that holds an animal with minimal distress or trauma. A humane killing trap is one that renders an animal irreversibly unconscious as quickly as possible.

Foothold Traps

Humane traps should also be practical and equally effective at capturing target animals and avoiding capturing non-target animals (Andelt et al. 1999). BMPs for the predator species in this EA identify key designs or modifications to foothold traps to reduce injury. Approved BMP-compliant foothold trap designs include regular jaw, padded jaw, offset jaw, double jaw, laminated jaw, double-laminated jaw, wide jaw, and some variations combining those features. The "jaw" part of a trap is the portion that makes contact with the foot of the animal being restrained. The various jaw types are designed to reduce injury by increasing surface area, reducing sharp edges, providing gaps to allow more circulation and decreased compression, or padding. They are also designed to minimize the movement of the foot, which allows for secure foot retention while decreasing the risk of injury.

Other features of traps to improve humaneness include anchors attached to the center point of the trap with swivels. Additionally, the use of shorter chain lengths with multiple swivels, and shock springs, help to reduce the impact to the animal when they attempt to pull free, while allowing 360 degree movement to reduce the risk of injury.

The skill-set and experience of the individual deploying the traps, combined with these trap modifications and features, complement the BMP guidelines by integrating the trap design, trap accessories, and trapper knowledge to improve humaneness.

Data from the more recent BMP testing is not currently available and awaiting for publication. However, BMP's for available species can be found at: http://fishwildlife.org/?section=best_management_practices, and are reference above in section 3.9.5.

Tranquilizer Trap Devices (TTDs) for Foothold Traps

The NWRC developed TTDs as a means of sedating animals captured in foothold traps to reduce the potential for self-inflicted injuries while held in the trap. TTDs are small rubber nipples fastened to the trap jaw filled with the tranquilizer propiopromazine HCL. When captured, predators instinctively bite the trap tab, ingest the immobilizing drug, and are sedated. Used properly, the sedative propiopromazine HCL (Investigational New Animal Drug #9528) does not render the animal unconscious. These devices have been mostly tested by APHIS-WS on trapped wolves.

Considerations for species, size, and pooled water may restrict the use of a TTD if a sedated animal was to have the potential to access such water (USDA 1998). This scenario could occur if a trap was set adjacent to a body of water or a captured animal pulled the trap loose from its staked anchor, with the trap attached to a grapple hook/ drag per requirements, allowing it to travel a short distance before full or partial sedation effects occurred. Another environmental concern is the ability of drugged and restrained animals to defend itself from predators and parasites.

Box and Cage Traps

Animals captured in box and cage traps for smaller predators, and culvert-type traps for bears may have fewer physical and behavioral traumas than those captured in snares and foothold traps. If checked regularly and used correctly, mortality rates may approach zero and wounds may appear to be less severe (Iossa et al. 2007). Generally, these traps are used if the animal is intended to be released, which is uncommon with PDM actions except in some circumstances for bears released off-site, with UDWR approval, or if the animal is relatively small, such as bobcats, opossums and raccoons, and the animal will be euthanized on-site. Canids or other trap wise animals appear to be truly reluctant to enter cage traps.

Foothold and Neck Snares

Effectiveness of snares depend greatly on the skill and expertise of the trapper, often causing them to be less effective than foothold traps when used by less experienced trappers (Skinner and Todd 1990, Onderka et al 1990). However, Turnbull et al. (2011) found traps and snares to be about equally effective with low levels of apparent injury and trauma. Foothold snares with stops set at the appropriate size for the target species (and to avoid non-target species capture) appear to have an acceptable effect on animal welfare, with little mortality of target species. However, animals typically have swelling of the foot, with possible long-term limping (Onderka et al. 1990). Darrow et al. 2009 cited Reiter et al. (1999) that public acceptance of the use of cable foot-restraints is slightly higher than for jawed foothold traps. The AFWA Western Coyote BMP identifies specifications for foot snare devices using 1/8 inch cable meet BMP compliance (BMP 2016, Onderka et al. 1990).

Bears can be effectively captured using modified foot snares. These snares can be readily transported into and set up in the backcountry, which is difficult with large culvert raps pulled behind vehicles. Under normal conditions, injuries may include swelling and abrasions. However, if the snare becomes entangled or the bear struggles energetically, severe injuries can result. Small bears held in traps are vulnerable to predation by larger bears. Cougars may also be effectively and humanely captured using foot snares (Powell and Proulx 2003).

When neck snares are set correctly as a restraint (not as a kill trap), using a stop on the cable, serious injuries are relatively uncommon, although the risk of mortality may be higher than with foothold snares. However, long-term survival is difficult to determine (Iossa et al. 2007). Increased size of the cable for both neck-hold and foothold snares can reduce lacerations but may also decrease effectiveness. Swivels give a struggling animal more flexibility and make it more difficult to entangle or twist the snare. Adding a tranquilizer tab (diazepam) to the snare may also decrease injuries, lunging, and vocalizations (Pruss et al. 2002, Iossa et al. 2007), with the limitations discussed above. Fall (2002) and Garvey and Patterson (2014) also found neck snares with a positive lock, such as Collarum™, to be humane, resulting in fewer injuries to target animals, when set by experienced trappers (APHIS-WS does not endorse any brands). This is a newer model, dependent on a cable loop triggered by pulling on a baited bit piece, and is selective especially for coyotes and dogs (Huot and Bergman 2007). Snares are also effective in a variety of weather, but use in cold weather should be avoided to minimize risk of limb freezing.

Frey et al. (2007) used snares to live-capture red fox for fitting with radio collars and found the foxes were active the evening following capture and that all females captured reared young the following spring. Over the three-year study period, the authors caught 21 foxes with neck snares, with only two fatal injuries.

Both foot and neck restraint snares can capture non-target species, with risk of mortality. Adding a breakaway snare lock, snare stops, and appropriate pan tension can minimize capture of non-target species and reduce the risk of holding a non-target animal (Iossa et al 2007).

Shooting and Pursuit with Dogs

WS-Utah uses shooting and pursuit dogs on a routine basis. Firearms are used for all species once the animal is controlled. Shooting, when applied by a skilled and experienced shooter, is highly selective and humane, causing immediate death when aimed to kill (AVMA 2000, Huot and Bergman 2007, Julien et al. 2010).

Pursuit of cougar and bears with trained dogs can be very effective. Once the animal is either treed or cornered, the animal is typically shot but can be tranquilized when requested by UDWR prior to WS-Utah personnel taking action. A possible concern using pursuit dogs is causing the animal to be physically exhausted, as well as possibly being injured before or during handling (Powell and Proulx 2003).

Elbroch et al. (2003) found that the number of hounds used in a cougar capture attempt did not necessarily predict the likelihood of capturing a cougar, although that is dependent on the skills and experience of both the dogs and the handler. Injuries to dogs and cougars may also depend on the skills and experience of the dogs and handler. The authors suggest that foot snares are a potentially safer and more humane capture method for cougar than pursuit with dogs when cougars are targeted in grassy or open areas with limited opportunities to tree or escape, but hounds may be more effective in habitats with refugia (places to tree or escape) in habitats. Dogs work best when a target cougar is actively working the site, as they may not return to the depredation or threat site, or may not return for several nights. The authors did not provide details on the breed and training of the pursuit dogs used, nor the level of experience of the dogs, which can differ substantially among pursuit dog handlers. Dogs bred and carefully trained for pursuit of large predators, such as those used by WS-Utah personnel, are important for consistent safety and effectiveness.

What are the Considerations for Humaneness for Different Chemical Methods?

Chemical methods may be used for lethal take, such as gas cartridges, M-44s, and euthanization, or for non-lethal take, such as immobilization. Impacts on human health and safety and the environment for chemical methods are evaluated in Section 4.6.

M-44 Sodium Cyanide

WS-Utah uses sodium cyanide (NaCN) capsules to remove individual coyote, red fox, gray fox, and feral dogs that prey upon livestock, poultry, and federally designated threatened or endangered species. The M-44 spring ejector device delivers a single dose sodium cyanide capsule directly into the mouth or face when the animal bites and pulls up on the spring-activated bait device, pushing the dry sodium cyanide powder into the mouth. Sodium cyanide reacts rapidly with moisture in the mouth or mucus membranes of the nose and eyes to form hydrogen cyanide (HCN), a poisonous toxicant. One sodium cyanide capsule contains enough cyanide to be lethal to animals that come in contact through the mouth, the skin, or through inhalation. Cyanide is a rapid-acting asphyxiator, causing death within minutes by depressing the central nervous system, resulting in respiratory arrest. Inhalation toxicity quickly causes disabling muscle weakness, vomiting, convulsions, bloody saliva, and loss of consciousness.

M-44s are highly selective for canids (Section 4.6.7.1) and have many restrictions in their use per the label (Appendix E), including in areas away from human activities in public areas, with warning signs in the area. The animal normally dies quickly in the field, within one to five minutes due to major depression of the central nervous system, cardiac arrest and respiratory failure (Section 4.6.7.1). The risk of the animal being observed by a person before death is very low because of the restrictions.

Gas Cartridge for Denning

WS-Utah uses the Large Gas Cartridge (EPA Reg. No. 56228-21) in rangelands, crop, and non-crop areas to remove coyotes, red foxes, and skunks in dens and burrows. The registered gas cartridge product contains the active ingredients sodium nitrate and charcoal, and two inert ingredients (Fuller's earth and/or borax, which control the rate of burn in the burrow; Johnston et al. 2001). The sodium nitrate supports the combustion of the charcoal, which emits carbon monoxide inside the enclosed burrow while burning. Like oxygen, the primary route of entry for carbon monoxide into an animal is through breathing. Carbon monoxide is poisonous to all animals, like mammals, that use hemoglobin to transport oxygen from the lungs to the cells of the body. Carbon monoxide attaches to hemoglobin to form carboxyhemoglobin, which causes a decrease in oxygen to cells throughout the body resulting in asphyxiation. During the combustion/burning process, oxygen in the burrow is depleted through the combustion of the charcoal.

AVMA (2013) documents that the use of 6% CO on dogs for euthanasia resulted in 20 to 25 seconds of abnormal cortical function, during which the dogs became agitated, although it is not clear if this is a sign of distress; humans in this phase reportedly are not distressed. CO induces the loss of consciousness without pain and with minimal discernible discomfort. Death occurs rapidly at low concentrations. Personnel using CO must be highly trained and educated. With use by trained and experienced personnel, this is a humane method.

What Field Immobilizations Methods are Humane

Immobilization drugs are used infrequently by WS-Utah, primarily when need to release an unintentionally capture animal that can't be safely restrained or for animals that can't be euthanized on site but need to be safely transported elsewhere for release or euthanasia. Immobilization drugs can be administered with a hand syringe of a safely restrained animal, jab stick, or dart gun.

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.

Capture-All 5™ is a combination of Ketaset™ and Xylazine, and is regulated by the FDA as an investigational new animal drug. The drug is available through licensed veterinarians to individuals sufficiently trained in the use of immobilization agents. Capture-All 5™ is administered by intramuscular injection; it requires no mixing, and has a relatively long shelf life without refrigeration, all of which make it ideal for the sedation of various species.

Telazol™ is a combination of equal parts of tiletamine hydrochloride and zolazepam hydrochloride, and is a powerful anesthetic for larger animals, such as bears, coyotes, and cougars (Fowler and Miller 1999). Telazol™ produces dissociative unconsciousness, which does not affect the reflexes needed to sustain life, such as breathing, coughing, and swallowing. Following a deep intramuscular injection of Telazol™, onset of anesthetic effect usually occurs within 5 to 12 minutes. Muscle relaxation is optimum for about the first 20 to 25 minutes after administration, and then diminishes. Recovery varies with the age and physical condition of the animal and the dose of Telazol™ administered, but usually requires several hours. Although the combination of Ketamine HCl and Xylazine are effective, WS-Utah prefers to use Telazol™ for most of the species that are immobilized.

What Field Methods are Used for Humane Killing (Euthanasia)

During PDM activities, most captured animals are humanely killed in place, rather than immobilized and relocated.

AVMA (2013 Appendix 2) supports the use of barbiturates (such as sodium pentathol and phenobarbitol), carbon dioxide, carbon monoxide, and gunshot directly to the head for humane euthanasia.   Potassium chloride and other chemical drugs are used only when the animal is already immobilized.

Using the following unweighted criteria, a panel of fifteen experienced wildlife professionals evaluated eight methods of field euthanasia (Julien et al. 2010):

- Ability to induce loss of consciousness and death without causing pain.
- Time required to induce loss of consciousness.
- Reliability.
- Safety of personnel.
- Irreversibility.
- Compatibility with requirement and purpose.
- Emotional effect on observers or operators.
- Compatibility with subsequent examination or use of tissue.
- Drug availability.
- Human abuse potential.
- Compatibility with species, age, sex, and health status of animal.
- Ability for equipment to be maintained in proper working order in the field.
- Safety for predators or scavengers, should the carcass be consumed.

The panel found that carbon dioxide used with the proper equipment is highly humane and effective, especially for use on raccoons, skunks, and birds. Anesthesia is induced within one to two minutes without undue stress on the animal at CO_2 concentrations of 30% to 40%. However, this needs well-maintained equipment that may not be practical to carry in the field. Gunshot to the brain by an experienced field biologist is humane, instantaneous, and may be the quickest and only method available under most field conditions. All methods of euthanasia should be performed discretely and only by properly trained personnel. Barbiturates such as sodium pentathol and phenobarbitol depress the central nervous system and cause rapid death with minimal discomfort through respiratory and cardiac arrest. With intravenous injection, death typically occurs within 25 to 300 seconds, meeting the standard for humaneness.

The American Society of Mammalogists (1998) concurs that shooting is the most effective and humane method of euthanasia in the field if conducted by experienced personnel. Carbon dioxide is also effective and humane, but more difficult to perform in the field without specialized, well-maintained equipment. The Society also recommends discretion when performing any kind of euthanasia when members of the public may be present.

The challenge in coping with this issue is how to achieve the least amount of animal suffering with the constraints imposed by current technology. WS personnel are concerned about animal welfare. WS 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. WS and the National Wildlife Research Center are striving to bring additional nonlethal damage management alternatives into practical use and to improve the selectivity and humaneness of management devices. Until new findings and products are found practical, a certain amount of animal suffering could occur when some methods are used in situations when nonlethal damage management methods are not practical or effective. WS supports the most humane, selective and effective damage management techniques and would continue to incorporate advances into program activities. WS field employees conducting PDM are highly experienced professionals, skilled in the use of management methods and committed to minimizing pain and suffering. WS Program Directives, SOPs and training work to ensure that WS PDM methods are used in a manner that is as humane and selective as possible. Other practices which help to improve the efficacy, selectivity and humaneness of WS use of PDM methods include implementing Trapping Best Management Practices where appropriate for PDM actions and compliance with regulations.

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 (Costello 1992). Individual perceptions of the ethics of WDM and the appropriateness of specific management techniques depend on the value system of the individual. These values are highly variable (Schmidt 1992, Teel et al. 2002), but can be divided into some general categories (Kellert and Smith 2000, Kellert 1994 Table 4-8). An individual's values on wildlife may have components of various categories and are not restricted to one viewpoint. The tendency to hold a particular value system varies among demographic groups.

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

Table 4-8. Basic wildlife values [Taken from Kellert and Smith (2000) and Kellert (1994)].

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

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

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

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

A third philosophy takes the view that overpopulation of an animal species (whether natural, man-induced or artificial) leads to increased animal suffering when the population suffers malnutrition, disease outbreaks of epidemic proportion or populations crashes due to exceeding the environmental carrying capacity. Advocates for this approach suggest that it is man's obligation to manage animal populations in a manner that reduces potential suffering to a minimal level (Beauchamp and Frey 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 such as feral swine.

When evaluating issues relating to the ethics of conserving or controlling nature, another approach is to consider the reason for the action as the determination of whether the action is ethical or not. One model using this approach involves assessing actions from the point of view of humans only (anthropocentric) or from a more general view of all living organisms (biocentric) that considers any harm to living creatures that can be avoided as immoral (Haider and Jax 2007). These approaches have been considered for conservation decisions, but could also be applied to PDM decisions such as those discussed in this EA.

A simple model for determining the ethics of a potential action proposes assessing whether the action is necessary and whether it is justified. In this model, if "yes" is the answer to both questions, the action is ethical (Littin and Mellor 2005). Although the considerations relating to each of these questions may involve several factors, only the two basic questions need to ultimately be answered using this model.

Yet another approach developed a set of six major criteria that can be used to design a pest control program that is ethically sound (Littin et al. 2004). The six major criteria are:

1. The goals, benefits and impacts of action must be clear.
2. The action should only be taken if goals can be achieved.
3. The most effective methods must be used to achieve goals.
4. The methods must be used in the best ways possible.
5. The goals must be assessed.
6. Once goals are achieved, processes should be in place to maintain results.

Using this model, an ideal project is one that follows all six criteria above (a "gold standard" project). If not all six criteria 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.

Models assigning numerical values to criteria have been proposed to assist in decision- making for alternatives when faced with animal disease outbreaks. One such model attempts to incorporate social ethics as one of the major criteria to be ranked, assigning numerical ranking to issues such as animal welfare (Mourits et al. 2010). Although the primary application of this model is for disease outbreaks, it could also potentially be applied to PDM.

The issue of ethics is evolving over time (Perry and Perry 2008), but no one commonly- accepted standard for the evaluation of ethics relating to control of animal pests exists. Any of the above models, alone or in combination, may provide additional consideration of the ethics of a proposed action. WS has numerous policies, directives and SOPs that provide direction to staff involved in wildlife control reinforcing the achievement of the most appropriate and effective WDM program possible. Many of these guidance documents incorporate aspects of the ethics consideration issues discussed above. Directives pertaining to WS' activities may be located using the WS home page at https://www.aphis.usda.gov/.../wildlifedamage.

Alternative 1 would be unacceptable to animal rights advocates, individuals with strong Humanistic and Moralistic values and to others with strong emotional or spiritual bonds with certain wildlife species. Some individuals assert that killing the offending animal is not the response of a moral or enlightened society. Response of other individuals and groups would vary depending on individual assessments of the need for damage management, risk to the target animal population, risk to nontarget 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.

4.5.1 Alternative 1 – Current WS-Utah Adaptive Integrated PDM Program (No Action /Proposed Alternative)

The PDM methods available for use in the current program are described in Appendix E, and will not be repeated here. Under the current program, all methods are used as selectively and humanely as possible, in conformance with the APHIS-WS Decision Model (Slate et al. 1992) and APHIS-WS Program Directives.

Under Alternative 1, method use would remain the same, with heavy reliance on selective methods such as aerial PDM, call and shoot, and M-44s. Leg-hold traps would remain important tools on the summer range (including National Forest System lands). PDM methods for mountain lions and black bear will not change. In addition, producer implemented nonlethal methods would not change (Table 4-12).

Table 4-12. Cooperator Employed Nonlethal Methods Use in Utah during FY00.

Resource	# of Cooperators	Species	Method	# of Occurrences
Cattle	3	Coyote	Herding	3
			Conventional Fencing	2
			Relocate Livestock	2
	1	Mountain Lon	Herding	1
Sheep	32	Black Bear	Guard Dog	6
			Barrier Fencing	2
			Herding	13
			Other Husbandry	2
			Relocate Livestock	2
	2	Bobcat	Barrier Fencing	1
			Relocate Livestock	1
			Guard dog	1
			Herding	1
	167	Coyote	Conventional Fencing	20
			Guard Dog	121
			Guard Donkey	1
			Guard Llama	15
			Herding	166
			Other Husbandry	3
			Night Penning	2
			Relocate Livestock	18
			Shed Lambing	1
	4	Golden Eagle	Conventional Fencing	5
			Guard Dog	5
			Herding	8
			Relocate Livestock	5
	3	Red Fox	Guard Dog	2
			Herding	4
			Guard Llama	2
			Relocate Livestock	5
	13	Mountain Lion	Guard Dog	11
			Herding	15
			Relocate Livestock	1

Humaneness of Alternative 1

WS-Utah personnel are experienced and professional in their use of management methods, and PDM methods are applied as humanely as possible given current technology, research, workforce, and funding. WS-Utah personnel apply the WS Decision Model to develop management strategies to effectively resolve damage problems while considering the species responsible for the damage, weather, time of year, available methods, efficacy, humaneness and other factors before implementing the PDM strategy.

WS-Utah uses leg-hold traps with either offset jaws or rubber-padded jaws to reduce injuries. WS-Utah use of leg-hold traps and snares would be more humane, and the number of nontargets killed would be lower, if traps could be monitored at least daily. Unfortunately, the amount of territory that each WS-Utah Specialist is responsible for and the number of requests for assistance is such that WS-Utah personnel are typically not able to monitor traps every day. WS-Utah WDM policy are set by UAWDPB (Utah Agricultural and Wildlife Damage Prevention Board). Policies and laws set for public trapping and hunting are set through the UWB (Utah Wildlife Board).

In addition under this alternative, WS-Utah would consider and implement nonlethal methods for PDM when appropriate. Target predators would be captured as humanely as possible or shot by experienced WS-Utah personnel using the best method available. Target predators live-captured would be released, relocated or euthanized by the UDWR or WS-Utah, as appropriate. WS-Utah personnel strive for instantly lethal shots when shooting predators to achieve quick kills. This is the most humane and practical method of shooting that is available under field conditions and would minimize pain and suffering of the predators that are removed. Experience has shown that instantly lethal shots result in almost immediate death which aligns closely with principles of euthanasia described by AVMA (1993).

Toxicants are viewed as inhumane by some (Schmidt, 1989) regardless of the speed at which they cause death. Hooke et al. (2006) note that sodium cyanide is possibly more humane that Compound 1080, revealing that humaneness is a relative quality. The WS Decision Model considers humaneness as one of the factors in deciding which method or combination of methods to employ in resolving a depredation complaint.

Some persons will still view this Alternative as inhumane. Some animal activists believe this alternative is inhumane because they oppose all lethal methods of damage management. By implementing the Proposed Alternative 1, fewer predators would be injured or killed by non-professionals and fewer illegal toxicants would be used under this alternative which could be viewed as a positive effect on humaneness.

Selectivity of Alternative 1

Several of the methods employed under the current program are typically 100% selective for target species. These methods include aerial PDM, shooting from the ground, and denning. Cage trapping may take a few nontarget animals, but these animals can typically be released. LPCs are typically 100% selective for the offending coyote when an attack occurs and the collar is punctured. Foot snares set on livestock kills, and hounds trailing from a livestock kill are also typically 100% selective for offending mountain lions and bears.

While the methods discussed above are typically near 100% selective in killing only the target animals, other methods such as leg-hold traps, snares, and M-44s are somewhat less selective (Table 4-13). While some consider toxicants to be nonselective (Mitchell et al. 2004) LPCs can only be activated by a coyote biting the throat of a sheep of lamb. Further, placement of M-44s in close proximity to livestock depredation increases the selectivity for those coyotes implicated in the depredation events.

WS-Utah use of pan-tension devices makes use of leg-hold traps much more selective. Pan-tension devices increase the amount of weight required to set off the trap, and they are effective in significantly reducing the likelihood of capturing smaller nontarget species

Table 4-13. Selectivity of Leg-hold Traps, Snares and M-44s Used by WS-Utah from FY06 through 11 by Method.

Species	Traps[1]	Snares[1, 2]	M-44
Target			
Coyote	1691	1483	2256
Red Fox	271	185	150
Black Bear	6	159	0
Mountain Lion	6	61	0
6-Year Total	1974	1888	2406
Nontarget			
Badger	10	1	0
Bobcat	6	1	0
Skunk	6	4	0
Black Bear	1	0	0
Kit fox	2	0	0
Mt. Lion	0	2	0
Feral Dog	0	0	2
Moose	0	1	0
Porcupine	6	7	0
Jackrabbit	0	1	0
Pronghorn	0	1	0
Mule Deer	0	4	0
6-Year Total	31	22	2
% Selectivity	98.5%	98.8%	99.92%

[1] These figures refer to the lethal take of animals captured in leg-hold traps and snares. Nontarget animals captured and release are not included in these figures.

[2] These figures refer to animals caught in neck snares.

(Turkowski et al. 1984, Phillips and Gruver 1996). Pan-tension devices are always used by WS-Utah unless their use would preclude capture of the intended target species. WS-Utah personnel often try to reduce the need for setting traps or snares by trying to first remove problem animals by shooting. If shooting is unsuccessful or not feasible, then equipment must be placed to try and resolve the problem.

As used by WS-Utah, snares provide a similar level of selectivity for target species as achieved with M-44s. Spring-activated leg snares set for bears or mountain lions are typically 100% selective for the target species, but neck snares are less selective. The selectivity of snares is largely a function of how and where they are set. Neck snare use is limited in Utah, because most of the work is conducted around domestic sheep where guard dogs can be inadvertently captured.

As for any potential risks to nontarget birds of prey such as red-tailed hawks, ferruginous hawks, or golden eagles, the damage management methods being used and the way they are used preclude significant impacts to these species. WS-Utah policy require that traps not be set any closer than 30 feet from exposed carcasses, and this effectively limits the likelihood of catching nontarget birds in traps.

Use of livestock guarding dogs by sheep producers has been proven effective in preventing at least some predation losses (Green 1987), and use of guard dogs is generally perceived as a selective form of nonlethal damage management. But use of guard dogs may also involve deaths of target and nontarget animals. Timm and Schmidt (1989) documented that guard dogs in their study regularly killed deer fawns, and anecdotal evidence from APHIS-WS field personnel and livestock producers suggests that guard dogs sometimes kill coyote and red fox pups as well as deer fawns and elk calves. Llamas have also been advocated as effective livestock guarding animals (Franklin and Powell 1994), but some degree of nontarget hazard may likewise exist from the use of llamas for this purpose. Llamas are sometimes carriers of paratuberculosis (Johne's disease) which may be transmissible to native ungulates or domestic livestock (Wildlife Management Institute 1995). This disease involves a chronic wasting of the intestinal tract and associated lymphoid tissues, and there is no known cure.

Nontarget species may occasionally be taken during PDM activities. However, most nontarget animals can generally be released alive. However, WS-Utah personnel would minimize nontarget takes with careful placement of traps and use of pan-tension devices, or variation in capture methods. WS-Utah has entered into formal and informal Section 7 consultation with the USFWS regarding any adverse effects of the current program on T&E species, and the USFWS has concurred with WS-Utah assessment.

WS-Utah has also determined that none of the currently used PDM methods or associated activities has the potential to affect any listed plants, fish or mollusks.

Although Federal agencies are not required to consult with the USFWS regarding the potential impacts of their activities on sensitive or candidate species, WS-Utah has considered the potential adverse effects of predation on State sensitive species. WS-Utah rarely conducts predation management activities in habitats occupied by these species, and a review of WS-Utah PDM records since 1971 showed that none of these species have ever been taken by WS-Utah.

No adverse effects to T&E species are expected from the current/proposed program. The removal of target predators from a site may be beneficial to some species, including T&E and sensitive species, because reduced predation may increase survival of offspring or newly relocated individuals.

4.5.2 Alternative 2 – WS-Utah Operational Lethal Damage Management for Corrective PDM and Technical Assistance

Under Alternative 2, no lethal preventive damage management would be allowed. Methods used to resolve wildlife damage under this Alternative would be selected based on timeliness and site specificity. No consideration of other resources requested for protection would be allowed. Increased use of aerial PDM, and call and shoot methods would occur, with decreased use of M-44s. Leg-hold trap and neck snare use would remain unchanged. Producer implemented nonlethal methods would remain unchanged.

Humaneness of Alternative 2
The analysis for this alternative would be similar to the analysis for Alternative 1 after damage has occurred and been documented. This alternative could be considered more humane by activist groups opposed to WS-Utah activities because they oppose preventive PDM activities. However, this alternative could be considered less humane by the persons effected by predation (*i.e.,* this alternative would be considered less humane to the species or humans being depredated or affected).

Selectivity of Alternative 2
The selectivity of WS-Utah methods under this alternative would be similar to the analysis for Alternative 1. WS-Utah would use the same methods under Alternative 2 as under Alternative 1; however damage must occur before WS-Utah could conduct any PDM and increased use of traps, snares and M-44s would occur in the absence of preventive aerial PDM. Wagner and Conover (1999) concluded that the need for use of traps, snares, and M-44s for PDM was lower on sites with preventive aerial PDM than sites without preventive aerial PDM. Leg-hold traps, snares and M-44s have a greater risk of capturing a nontarget species than aerial PDM. Therefore, risks to nontarget species would probably be slightly increased under this alternative.

4.5.3 Alternative 3 - Nonlethal Damage Management Only

Under this alternative, WS-Utah would conduct predation management using only nonlethal methods. The use of neck snares, LPCs and M-44s would be eliminated, as would the practices of denning, calling and shooting and aerial PDM. Trapping may continue, but would be very limited and would be used only to capture animals for relocation, collaring or sterilization.

Humaneness of Alternative 3
This alternative would be considered humane by many people, especially animal activists and groups. However, resource/property owners may not perceive this alternative as humane, especially if they or their domestic animals are killed or threatened by predators. In addition, resource owners/manager could use lethal and nonlethal methods to reduce predator damage and their efforts may not be as humane as WS-Utah. In addition, some resource/property owners may take illegal action (*i.e.*, use unregistered or environmentally harmful toxicants) against localized populations of predators out of frustration of continued damage. Some of these illegal actions may be less humane than methods used by experienced WS-Utah personnel.

Selectivity of Alternative 3
The analysis of selectivity for Alternative 3 would be similar to the current program. However, Alternative 3 only allows the use of nonlethal methods which would not be appropriate for some PDM situations. Some target predators would become habituated to nonlethal methods and ignore the deterrent affect of that method (Pfeifer and Goos 1982, Conover 1982, Conover 2002, Shivak and Martin 2001).

4.5.4 Alternative 4 - Technical Assistance Only

Under Alternative 4, no federal operational PDM would exist; therefore no methods would be employed by WS-Utah personnel. Livestock producers or State and local agencies would likely conduct PDM, and possibly the use of methods under these programs would be less regulated. Illegal use of pesticides could occur, along with indiscriminant trapping. State law currently provides that red fox and coyotes may be taken by livestock producers without a license or season restrictions. Further, livestock producers or their employees may take a mountain lion or black bear, which has threatened or killed livestock within 72 hours of the event. This provision would allow for the killing of a black bear or mountain lion that had not killed livestock. Without the Federal WS-Utah program, producer implemented nonlethal methods would likely decrease, as producers focus their attention on lethal methods.

Humaneness of Alternative 4
The issue of humaneness under these alternatives is not applicable because resource owners or others would be responsible to implement the damage management methods (*e.g.,* WS-Utah may provide verbal assistance to requesters under Alternative 4, however, implementation of the methods would be the sole responsibility of the requester). Some resource owners may take illegal action against local populations of predators out of frustration or ignorance. Some of these illegal actions may be less humane than methods used by WS-Utah personnel.

Selectivity of Alternative 4

The selectivity of Alternative 4 and 5 would probably be less than the current program. There would be no operational WS-Utah activities under either of these alternatives, and hence no risks to T&E species from WS-Utah. Some type of WDM would most likely be implemented by livestock producers or private predator control programs, however, and these activities could pose greater risks than WS-Utah activities. Damage management efforts by individuals with limited training and experience would be more likely to take nontarget species, including T&E species. Without the Federal assistance available from WS-Utah, some requesters may be motivated to consider use of more economical forms of control than those practiced by WS-Utah. Illegal use of toxicants represents one of the cheapest forms of predator removal, but it also presents the greatest environmental risks. Risks to nontarget species and public safety would probably be greater under Alternative 4 than for any other alternative. Illegal use of pesticides could occur under these Alternatives, along with indiscriminant trapping by less experienced and qualified persons. Some resource owners may take illegal action against local populations of predators out of frustration or ignorance. Some of these illegal actions would be less selective than methods used by WS-Utah personnel.

4.6 EFFECTS OF WS-UTAH PDM ON PUBLIC AND PET SAFETY

4.6.1 Safety of WS-Utah Methods to Humans

WS-Utah methods have been widely used with minimal effects to the public for decades. WS-Utah supports the development of new methods to enhance safety, humaneness and selectivity through continuing research at the National Wildlife Research Center (NWRC). The NWRC is the only facility in the world dedicated specifically to resolving wildlife-human conflicts.

WS-Utah employees use and recommend only those methods which are legally available, selective and effective to resolve the wildlife conflict. Still, some concerns exist regarding the safety of WS-Utah methods despite their legality. As a result, WS-Utah will analyze the potential for proposed methods to pose a risk to members of the public, pets or employees of WS-Utah.

In addition to the potential risks to the public associated with WS-Utah methods, risks to employees are also an issue. WS-Utah employees are potentially exposed to chemicals during damage management methods as well as subject to workplace accidents. Selection of methods, following the Decision Model (Slate et al., 1992), includes consideration for public and employee safety.

This section evaluates the potential impacts and risks associated with mechanical and chemical PDM methods used by WS-Utah on environmental resources and human and domestic animal (including pets and livestock) health and safety. This includes effects on the environment as applicable for each method (water, soil, aquatic and terrestrial vertebrates and invertebrates, including wildlife) and members of the public, recreationists, hunters, and WS-Utah employees.

The analysis of each mechanical and chemical method is based on a thorough national *Risk Assessments* of each APHIS-WS method, with additional information included from WS-Utah activities and the literature where available. Assumptions about the lethal actions that others might take to address predator damage in the absence of WS-Utah or if WS-Utah lethal activities are restricted as described in Alternatives 2 through 4 are included in Section 4.3. All of the methods evaluated in this section are described in detail in Appendix E.

Other issues related to the use of these methods and chemicals are evaluated in the following sections:

- Efficacy of PDM: Section 1.11.1.2.
- Impacts on predator populations: Sections 4.3 and 4.4.
- Impacts on predator and non-predator populations, including federally-listed threatened and endangered species from unintentional take: Sections 4.3 and 4.4.1.2.
- Humaneness of methods: Section 4.5 APHIS-WS Directives and policies for the use of PDM methods.

Risks to the Public from Alternative 1

WS-Utah proposed methods pose no to minimal threat to human health and safety. It is the policy of WS-Utah that safety of WS-Utah employees and the public is of primary importance when WS-Utah personnel implement damage management methods to conduct official duties. WS-Utah implements a state-wide program of WDM based on an IWDM approach described in Chapter 3 of this EA. The greatest risks to human health and safety from WS-Utah use of chemical methods are incurred by the WS-Utah Specialists who use these methods. Likewise, the greatest risk to human health and safety from WS-Utah use of mechanical damage management methods is incurred by the WS-Utah Specialists who use methods such as aerial PDM. From FY12 through FY16 analysis period, there were no reported injuries to members of the public related to WS-Utah use of any WDM chemical or mechanical methods. Policies that address safety concerns about WS-Utah use of pesticides, traps and snares and other mechanical devices are listed at the end of Chapter 3.

WS-Utah follows firearm safety precautions when conducting damage management activities and complies with pertinent laws and regulations governing the lawful use of firearms. WS-Utah PDM activities using firearms are conducted in accordance with APHIS-WS firearms and WS-Utah firearms use and shooting policies and procedures in accordance with (WS Directive 2.615 and WS Firearms Safety Manual). In addition, to ensure safe use and awareness, WS-Utah employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within 3 months of their appointment and a refresher course every 2 years thereafter. Further, WS-Utah employees, who carry firearms as a condition of employment, are required to verify that they meet the criteria as set forth in the *Lautenberg Amendment* which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence. However, WS-Utah has no control over the safe use of firearms by producers or anyone else. The risk of a stray bullet inadvertently striking a member of the public is virtually eliminated by WS precautionary measures such as: shooting at a downward angle during aerial PDM, positively identifying target animals before shooting, using rifles that fire single projectiles per shot, using only specially trained and certified personnel.

Of the non-chemical WDM methods used by WS-Utah, leg-hold traps and neck snares pose the greatest risk to nontarget species. However, domestic pets that may be captured in these devices and accompanied by humans can be released unharmed. WS-Utah limits the use of leg-hold traps and snares on public lands during bird hunting seasons, and warning signs are always posted in those few areas where these devices are set on public or private lands. WS-Utah traps and snares would be strategically placed to increase efficacy while minimizing exposure to the public and pets, and appropriate signs would be posted on all properties where traps and snares are set to alert the public of their presence.

Of the chemical methods currently used for PDM by WS-Utah, M-44s and LPCs are the only methods that may present some degree of risk to the public or free roaming dogs. As discussed in Chapter 3, this risk is minimized by not placing M-44s where or when exposure to the public or pets is probable and by placing warning signs in the general area and adjacent to each M-44 device wherever M-44s are used to alert the public of their presence.

The LPC was designed to specifically target coyotes which attack the throat of sheep or goats. Other predators, including dogs that have attacked collared sheep by the throat have succumbed to the pesticide. Domestic dogs could also be susceptible to poisoning if they scavenged on a 1080-contaminated carcass of a sheep that has been killed by coyotes. The likelihood of this occurrence would be low because LPCs would only be used within fenced pastures, primarily on private lands, and the carcass of any dead sheep would be removed in conjunction with the regular monitoring requirements for use of the LPC. Risk would also be reduced because of the tendency of scavengers to feed preferentially in the area of the thoracic cavity and the hind portion of the carcass, while the 1080 contamination would be limited primarily to the wool on the sheep's neck. The *Risk Assessment* concluded that use of the LPC would pose little likelihood of a person or dog being poisoned and there are no significant secondary hazards associated with the use of LPCs (WS 2017).

EPA conducted a review of APHIS-WS use of the M-44 and LPC and determined that allegation of potential bioterrorism threats arise from APHIS-WS use of the M-44 and 1080 LPC were unfounded (Certified mail to W. Keefover-Ring, Carnivore Protection Program from D. Edwards, Office of Pesticides Programs, EPA, Washington, D.C., January 16, 2009). EPA acknowledged that sodium cyanide and Compound 1080, like other pesticides and chemicals, are acutely toxic to humans and acknowledged the significance of the findings from USDA OIG's past audits of WS-Utah. According to the USDA OIG, WS-Utah has made dramatic improvements to its handling of these pesticides. EPA believes extra consideration is being given to ensure supplies of pesticides containing sodium cyanide and Compound 1080 are adequately protected[25]. As of April 2007, WS-Utah has obtained closure of all the audit recommendations through strengthened management controls and improvement in the program's inventory process. Moreover, EPA has consulted with the Department of Homeland Security (DHS), and the DHS agrees that cancellation is not necessary from a homeland security perspective. Given the DHS position and the corrective steps WS-Utah has taken, EPA does not believe cancellation is either necessary or appropriate from a homeland security perspective.

25 APHIS WS-Utah has made significant modifications to their chemical security procedures based on recommendations from the USDA OIG and implemented through their own new directives for protecting hazardous materials.

EPA also does not believe that the presented information or arguments warrant cancellation of the M-44 and LPC. Further, as to the use of the M-44 and 1080 LPC posing an unreasonable risks to the environment, EPA finds: 1) a number of the issues raised seem directed against lethal predator control practices generally, rather than the M-44 and 1080 LPC registrations specifically, 2) most of the arguments raised in the petition are similar to the arguments that have been considered by EPA in its previous decisions relating to the M-44 and LPC, and 3) that the risks presented by theM-44 and LPC are not unreasonable because of homeland security concerns and the ESA. In conclusion, EPA finds that there does appear to be benefits associated with the M-44 and LPC and that the lawful use under EPA registration labels do not result in unreasonable adverse effects on the environment or that there is any likelihood that cancellation would be appropriate or successful. Therefore, EPA determined not to cancel the registration of the M-44 or LPC.

This alternative would have no to very minimal adverse effect on human or pet health and safety. However, a positive effect on human safety and health would result from a reduced risk of "*bold*" predators. 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. This alternative would reduce threats to public health and safety by removing bold predators from a site, and thus reducing potential exposure of the public or pet to a predator(s) that would threaten their safety and wellbeing.

Risks to the Public from Alternative 2

Alternative 2 would also involve using all the same tools and methods as the Current Program, but they would not be used in any preventive damage management actions. In the absence of preventive aerial PDM, WS-Utah would likely have a slight increase the use of traps, snares and M-44s, all of which are less selective than aerial PDM. This could slightly increase risks to public and pets, but risks would still be low because of standard practices employed to reduce any potential risks.

The risks to the public from WS-Utah methods under this alternative would be similar to the analysis for Alternative 1. However, damage would need to be documented before actions from WS-Utah could occur. WS-Utah actions or lack of action, under this alternative, would increase risks to the public from predator damage or bold predators that had become habituated to humans and domestic pets and depredated upon humans or their pets/animals.

Risks to the Public from Alternative 3

Nonlethal methods, exclusion, habitat modifications, etc., would not be efficient or successful in resolving many predator damage situations and predator would habituate to nonlethal methods (Pfeifer and Goos 1982, Conover 1982, Conover 2002, Shivak and Martin 2001). Additionally, resource owners may attempt to lethally resolve predator damage problems through illegal use of chemicals/pesticides, trapping, and shooting without WS-Utah expertise, and there may be increased risks to public and pet health and safety from improper or inexperienced use of these methods. Because WS-Utah methods use under the current program are non-hazardous to the public and only nonlethal methods could be used under this Alternative, there would be increased risks to the public from implementation of Alternative 3 because nonlethal methods may not be appropriate for all damage management situations (*i.e.,* bold predator threatening public health and safety).

Risks to the Public from Alternative 4

Both of these alternatives would result in no Federal operational WDM program in Utah, therefore the use of methods would be at the discretion of individuals or agencies that conduct the activity. The low risks associated with WS-Utah use of WDM methods would be nonexistent under this alternative. WS-Utah would make recommendations under Alternative 4, but implementation of the recommendation would be by some other entity. However, increased use of the same methods by less skilled trappers or livestock producers, and greatly reduced restrictions on how WDM is conducted may result in an increased risk to the public. No program would be available for the protection of human health and safety, and UDWR would not have access to WS-Utah Specialists in the event of black bear or mountain lion threats to human safety.

Technical assistance only to the public or no program would not be efficient or successful in resolving many predator damage situations. Additionally, resource owners may attempt to lethally resolve predator damage problems through illegal use of chemicals/pesticides, trapping, and shooting without WS-Utah expertise, and there may be increased risks to public and pet health and safety from improper or inexperienced use of these methods. Because WS-Utah methods use under the current program are non-hazardous to the public there would be increased risks to the public from implementation of Alternative 4.

4.6.2 What are the Potential Impacts and Risks Associated with Mechanical/Physical Methods

Mechanical/physical methods include physical capture devices, such as cage traps, cable restraints, foothold traps, and quick-kill/body grip traps. Additionally, the use of firearms, aerial PDM, trained animals, and supplemental black bear feeding are distinct methods, but also are often used in conjunction with physical capture devices. The impacts and risks associated with lead ammunition associated with these mechanical/physical will be discussed in (Section 4.6.6)

4.6.2.1 What are the Potential Impacts and Risks Associated with Physical Capture Devices

WS-Utah uses four primary types of physical capture devices during PDM activities – cage traps, cable restraints (both foothold and neck snares), foothold traps, and quick-kill/body grip traps.

The Association of Fish and Wildlife Agencies (AFWA) has developed voluntary Best Management Practices (BMPs) for trapping furbearers in the United States (Batcheller et al. 2000). Evaluations of trap and snare performance was based on animal welfare, efficiency, capture rate, selectivity, practicality, safety, mechanical function, cost, quality, durability, weight, and maintenance requirements (Fall 2002). The BMPs were provided to state and federal wildlife agencies, trappers, and the public in the form of a general overview of traps and trapping, and as guidance on the most efficient and humane methods for trapping 24 furbearer species in the United States (AFWA 2017). The BMP program uses international humane trapping standards consistent with the Agreement on International Humane Trapping Standards among Russia, Canada, and the European Union. WS Policy (WS Directive 2.450) states that the use of the BMP trapping guidelines developed and promulgated by AFWA (2017) for private fur harvest and other trapping activities are valuable and should be followed as practical. WS has adopted these standards, where feasible, for trapping in the United States and continues to assist in research on different trapping systems.

Risks related to the use of mechanical/physical capture devices by APHIS-WS are examined in detail in several *USDA, APHIS, WS Human Health and Ecological Risk Assessments(Risk Assessment)*..

Cage traps allow target animals to enter inside a wire mesh or panel enclosure and prevent the animals from exiting once trapped, usually through a door which shuts behind them when they enter. These capture devices are generally set on the ground in areas where target animal activity is expected to be high, such as at burrow openings and along travel corridors, and are typically baited with bait specific to the target animal.

Depending on the species and state law and regulation, the target animal is usually quickly euthanized using a firearm or, may be transferred to UDWR for their disposal or release. Non-target animals can be readily released unharmed on-site with low risk to the WS-Utah employee, who stands behind the trap open the door to release the animal, which typically runs away from the trap.

Risks related to the use of cage traps by APHIS-WS are examined in detail in the *WS Use of Cage Trap Risk Assessment* (WS 2017d).

Cable restraints, either foot or leg snares or neck snares are typically made of wire cable, and have a loop, a lock on the loop so it doesn't reopen after activation, and a stop so that smaller non-target animals can escape, and may or may not have a trigger. Most snares are equipped with a swivel to minimize cable twisting to avoid breaking the cable or harming the animal. Some snares have breakaway devices that allow larger non-target animals to break free. Snares are typically placed where the target animal moves through a restricted place, such as a trail under a fence or burrow entrances.

Risks related to the use of cable restraints by APHIS-WS are examined in detail in the *WS Use of Cable Restraints Risk Assessment* (WS 2017e).

Foothold traps, often traditionally called leghold traps, are mechanical devices designed to capture animals by gripping a foot. A foothold traps consists of a pair of metal jaws sometimes laminated or covered with rubber pads to reduce injury. In addition to these, other trap styles are available for raccoons (e.g., dog-proof raccoon trap, and foot-encapsulated trap) that exclude many nontarget species. Species-specific baits and lures are used to bring target animals into the vicinity of the trap to ultimately position it for capture.

About 31% of all WS-Utah intentional captures of predators are conducted with foothold traps, with about 87% of the captured animals being coyotes (Table 4-11). The remainder are primarily smaller predators. Most of the animals caught using foothold traps are quickly killed with a firearm when found in the trap. An average of nine predators, with badgers apparently most vulnerable, are unintentionally captured and killed every year using foothold traps and an additional one to eight are captured and freed every year (Table 4-7).

Risks related to the use of foothold traps by APHIS-WS are examined in detail in the *WS Use of Foothold Trap Risk Assessment* (WS 2017f*).*

Quick-kill/body-gripping traps are frequently used in PDM for removing small to medium-sized predators. The lethal body-gripping trap is made up of a pair of wire frames that close with force when triggered with a quick body blow. Most common quick kill/body gripping trap used is the conibear style trap.

APHIS-WS policy prohibits the use of body-gripping traps with a jaw spread exceeding eight inches for land sets, and OAR §635-050-0045 prohibits the use of "any killing trap having a jaw spread of 7.5 inches or more but less than nine inches, in a set on public lands, at a distance greater than 50 feet from a permanent water source or a seasonal water source when water is present. Smaller body-gripping traps may be placed at the opening of a baited cage-type trap or box. Quick-kill traps set for predators are primarily used in rural areas or set in ways to limit non-target exposure.

Risks related to the use of foothold traps by APHIS-WS are examined in detail in the *WS Use of Quick-kill Trap Risk Assessment* (WS 2018RA14*).*

4.6.2.2 What are the Potential Impacts of Physical Capture Devices on Soil, Water, and Terrestrial and Aquatic Species

Cage traps, metal foothold traps, quick-kill traps, and snares are physical devices that have little to no potential to affect soil, water, terrestrial plants, freshwater and terrestrial invertebrates, amphibians, reptiles, and fish. Food baits, such as tuna fish, eggs, meat, or peanut butter, are sometimes used to encourage target animals to investigate and enter or activate traps; however, the amount of natural bait is small, and quickly decomposes or is eaten by small animals or insects. When the trap is pulled, the WS-Utah employee removes and discards any remaining bait. Although plant matter may be used to hide or camouflage the trap, this is usually dead material already existing in the trap area, such as sticks or plant debris.

Therefore, there is little to no potential effect on soil, water, or terrestrial plants by the use of physical capture devices when used either by WS-Utah employees and/or any other person.

4.6.2.3 What are the Potential Risks from Physical Capture Devices on Public Health and Safety, Including Recreationalists and Hunters, and to Pets

Per WS Directive 2.450, capture devices should be set to minimize the visibility of captured animals to the public (Section 2.4 A2). . Most PDM activities are conducted away from areas of high human activity except when directly applied on private landowner property to address a specific damage problem. If the risk of people being present exists, then activities are conducted during periods when human activity is low, such as at night or early morning, whenever possible.

Bilingual warning signs are used near trap sets placed on public lands to alert the public to avoid potential problems with either public or pet hazards from traps or captured animals. Live traps, culvert traps, and snares set for black bears are placed so that captured animals are not readily visible from any designated recreation road or trail or from federal, state, or county roads and, if used in areas with bears damaging campgrounds, development dumpsters or other areas where the public frequents, signs are placed on each end of the culvert trap to warn people away ().

Use of traps and snares is restricted in public safety zones designated in USFS or BLM Annual Work Plans for PDM on federal lands. A public safety zone is one-quarter mile, or other appropriate distance, around any residence or community, county, state or federal highway, or developed recreation site. PDM conducted on federal lands within identified public safety zones are generally limited to activity conducted for the protection of human health and safety. However, a land management agency or cooperator could request PDM activities in the public safety zone for another type of identified need, as approved by the managing agency. Depending on the situation and applicable laws and regulations, Federal permittees could request either WS-Utah or others to conduct PDM activities. However, the land management agencies are notified by WS-Utah of PDM activities that involve methods of possible concern, such as firearms, dogs, and traps, before these methods are used in a public safety zone, unless specified otherwise in the Annual Work Plan and as appropriate. This is not the case for PDM work conducted by other entities or individuals.

Therefore, the potential for the public, recreationists, hunters, pets, landowners, and domestic livestock to encounter and be captured or killed by a trap or snare set by WS-Utah and/or any other person/entity is very low on private lands and highly unlikely on public lands.

4.6.2.4 What are the Potential Risks of Using Physical Capture Devices to WS-Utah Employees

WS-Utah employees operating in the field work with physical capture devices routinely, and also have a high potential to encounter and handle wildlife, both live and dead, as part of their daily work. The health and safety hazards associated with the use of physical capture devices potentially include cuts, abrasions, bruises, or bone fractures for the hands or fingers from the accidental discharge of a trap or the trigger of some snares. Most injuries occur while setting or placing metal foothold traps. Setting traps also involves bending, kneeling, and pounding and pulling stakes, which could potentially lead to back strains. When using snares, an employee may be cut on broken strands of cable.

APHIS-WS field employees are experienced and knowledgeable in the use of traps and snares, and handling of animals under stress. APHIS-WS field employees whose duties involve animal capture are required to take intensive courses (WS Directive 2.450, Section 2.4 A2a). They must also participate in periodic firearms training (WS Directive 2.615, Section 2.4 A3a), which is important when firearms are used to euthanize captured animals.

Because of the potential for getting bitten by a wild animal that may be diseased, WS Directives 2.601 and 2.635 (Section 2.4 A12) are specific for protecting employees from this hazard.

Supervisors of field employees are responsible for identifying possible hazards, including wildlife-borne diseases, and ensuring that employees are provided information, training, and personnel protective equipment (PPE), especially safety glasses and heavy gloves, to optimize employee safety. Employees are empowered to immediately report unsafe working conditions to their supervisor. Because of the potential for doctors to misdiagnose wildlife-borne diseases because of their rarity in the general population, employees are advised to alert their doctors of the potential for exposure, and all field employees are provided with a Physician's Alert Card with pertinent information about the more relevant diseases. The APHIS-WS Biological Risk Management Training Manual provides information about disease safety, biosecurity, and PPE use.

When using cage and culvert traps, the risk to employees from captured animals is minimal. The animal is entirely enclosed in the trap and can be readily moved (if captured in a public area) and released with little risk to the employee, as the door can be opened while the employee is safely behind the door. Animals can also be immobilized and/or euthanized while still inside the trap. Bears are often immobilized inside the trap using a pole syringe before being euthanized outside the trap; other species are euthanized directly in the trap, usually using a firearm (Appendix E). Most reported bites have occurred from handling live animals at the APHIS-WS NWRC laboratory, not in field conditions.

If the animal is to be transported for release or euthanization away from a public place, the animal is usually immobilized for safe handling (Appendix E). Smaller animals can be handled with a catchpole to control the animal and prevent or minimize risk to the employee or animal. Securely staking the trap rather than using a drag holds the animal in place, avoiding the surprise of finding an animal that has moved from the original trapping location and minimizing the risk of attacks and bites.

Employees may also get bitten or scratched while setting an animal free or attempting to euthanize a captured animal. The bite from a wild predator has the potential to carry disease, which can infect the employee. The risk of being bitten is primarily from live-traps such as foothold traps and snares. Quick-kill body-grip traps are intended to immediately kill the animal when the trap is triggered, so the risk of an employee being bitten is extremely low.

There are no records of employees receiving broken fingers from handling leg-hold traps and activating snares, although minor injuries have occurred.

Nationwide, from FY 2008 through FY 2012, APHIS-WS field personnel were bitten 14 times (one bear, one coyote, two feral cats, three feral dogs, two bats, one pelican, and four unknowns). Since 2013, an average of only 2.3 animal bites were recorded nationwide, with two of those bites from cats and dogs. Wild animals under stress from handling can behave unpredictably, probably causing the bites. However, since most animals are safely euthanized while still captured, this potential is low.

4.6.3 What are the Potential Impacts and Risks from the Use of Firearms and Firearm-like Devices?

Firearms, including rifles, pistols, air rifles, and shotguns, are used on a frequent or even daily basis by APHIS-WS and WS-Utah field employees to lethally take or euthanize wildlife during WDM activities. Firearms are one of the most frequently used methods by APHIS-WS field employees, and are used in all types of settings including urban and rural areas, but only where they can be used safely. Because firearms are inherently dangerous and use may occur under difficult conditions or high-profile public circumstances, all use must be safe, accurate, and with high competency. Therefore, APHIS-WS requires extensive training and certification for employees to use firearms (WS Directive 2.615, Section 2.4 A3).

APHIS-WS field employees are required to take extensive and repeated training and receive certification for use and proper storage of firearms and firearm-like devices (WS Directive 2.615, Sections 2.4 A3 and A4), including the proper use of personal protection equipment (PPE) such as ear protectors and glasses. Training in the proper and safe use of firearms consists of an initial training course, followed by a requirement for continuing education on an annual basis. To ensure APHIS-WS employees receive uniform firearms safety training, National Rifle Association (NRA) certified instructors and the NRA's curriculum for the basic pistol, rifle, and shotgun certification is the only officially recognized program of initial firearms safety training for new APHIS-WS employees. The training requirement for firearm-like devices, at a minimum, includes the NRA's curriculum for the basic pistol, rifle, or shotgun certification that best fits the device's profile. New APHIS-WS employees cannot use government or personal firearms in an official capacity until they have completed the NRA Basic Firearm Course pursuant to the firearms the employee will use on the job. Once that training is completed, annual firearms safety continuing education is required. A component of the training is learning to estimate the distances that a projectile of a certain type will travel (maximum projective range), in order to avoid unintended damage or injury in the case of a missed target.

APHIS-WS personnel who use firearms are subject to new applicant drug testing, random drug testing, reasonable suspicion testing, and post-accident testing. As a condition of employment, APHIS-WS employees who carry and use firearms are subject to the Lautenberg Domestic Confiscation Law, which prohibits firearm possession by anyone who has been convicted of a misdemeanor crime of domestic violence (18 USC §922(g)(9)).

The humaneness of using a firearms for removing or euthanizing animals is discussed in (Section4.6.3). The use of firearms during aerial activities is discussed in (Section 4.6.4). APHIS-WS policy for use of firearms is found in WS Directive 2.615.

APHIS-WS employees adhere to three basic safety rules, including always pointing the firearm in a safe direction, always keeping fingers off the trigger until ready to shoot, and always keeping the gun unloaded until ready to use.

The risks to human health and safety and the environmental impacts and fate for lead used in ammunition are found in (Section 4.6.6) In addition, further detail on risks associated with the use of firearms and lead ammunition maybe found in the *WS Use of Firearms Risk Assessment* (WS 2017h).

APHIS-WS field personnel select firearms appropriate to an intended use, and which include rifles, shotguns, air rifles, or pistols. For example, WS-Utah personnel may use a larger caliber rifle to take bears or a smaller caliber rifle for raccoons. Field employees base the selection of weapon type and size on several factors, including the target animal, likely distance to target, humaneness, accuracy, safety, and noise in sensitive areas. Field employees generally use rifles, rather than shotguns or handguns, to target animals accurately at greater distances or that are not restrained. Field employees base the selection of shotgun gauge and shot size on several factors, including the species of target animal, likely distance to target, humaneness, accuracy, safety, and noise. Shotguns are generally used to target animals at distances less than 100 yards, and in most cases, less than 50 yards. Modified shotguns can also be used for non-lethal purposes, such as to fire pyrotechnics such as shell crackers to disperse target animals and discharge rubber projectiles to physically hit and frighten animals. Shotguns are also used during aerial PDM to limit the risk of ricochet and increase effectiveness and efficiency of humanely killing the target predator (Section 4.6.4). Handguns such as pistols are used for close-range shooting of a captured animal or for protection from attack by wild animals such as bears or feral dogs.

Firearm-like devices are firearms that have been modified to fire 12-gauge cracker shells and non-lethal rubber bullets or beanbags for harassment. Immobilizing dart-firing guns are firearms modified to fire immobilizing agents in darts from a safe distance. They are used when an animal needs to be immobilized or for moving animals to reduce stress and increase handler safety. Firearms that have been modified to fire non-lethal rubber bullets or beanbags are used to harass and disperse target animals. Paintball guns and rubber bullets may be used for harassing predators.

All firearms are safely carried and stored per WS Directive 2.615.

4.6.3.1 What are the Potential Impacts from to the Environment from the Use of Firearms

Firearms are highly selective when used by experienced and trained personnel. APHIS-WS personnel are highly trained in safety, target selection, and humaneness training and experience. There is no impact on the environment when a firearm is used as a euthanizing agent at very close range, and an impact on the environment is highly improbable when a firearm is used at the appropriate distance from the ground or from an aircraft.

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 or inappropriately high-visibility to the public, or to detect and shoot target animals that are active at night, such as coyotes. Specialized equipment, such as lights, night vision, and thermal imagery, increases the selectivity and accuracy of firearm use at night.

Most shotgun shell casings (hulls) are plastic with a brass end (a mixture of mostly copper with some zinc alloys); bullet casings are mostly made up of brass. Bullet casings from centerfire rounds, rimefire rounds and shotgun hulls may be left on the ground, but are typically retrieved by field personnel, with the exception of shotgun hulls from aerial PDM. Brass is generally resistant to environmental corrosion, and oxidizes over a very long period of time. The primers are also generally made up of brass. Materials making up the explosives in the primer are burned upon contact. Plastic shell hulls are mostly made of high-density polyethylene plastic and, sometimes, a low-density polyethylene plastic. If not retrieved, the plastic will degrade into small pieces in sunlight over a long period of time. Paper wads in the projectile follows the shot for a distance, then fall to the ground to degrade quickly.

Firing at target animals with harassment projectiles is always conducted at a sufficient distance to both cause the animals to flee and not intentionally to harm the target animal. Paintballs used in hazing are non-toxic to the environment, biodegradable and soluble in water. Most of the ingredients are food grade.

With the high level of proficiency and safety training provided to APHIS-WS and WS-Utah field employees and when firearms are used according to WS Directives and training, the use of firearms and firearm-like devices is highly selective and have a negligible impact on the environment.

4.6.3.2 What is the Accident Risk of WS-Utah's Use of Firearms to the Public, Including Recreationists and Hunters, and Pets

APHIS-WS and WS-Utah employees are highly trained and proficient in the use of firearms, as discussed in the previous section. They are trained to know the distance that different ammunition types fired from various firearms may travel before losing energy, and, as is necessary for all people using firearms, are highly cautious and aware of the potential for recreationists and hunters to be in the area. APHIS-WS has never had an accidental shooting of any member of the public. The employee is observant for the potential for other people or pets to be within firing range at all times, and only uses a firearm when it is safe to do so.

The risks to human health and safety and the environmental impacts and fate for lead used in ammunition are found in (Section 4.6.6). In addition, further detail on risks associated with the use of firearms and lead ammunition maybe found in the *WS Use of Firearms in Wildlife Damage Management Risk Assessments* (WS 2017h).*USDA, APHIS, WS Risk Assessment* and *Chapter XII: The Use of Lead in Wildlife Damage Management*..

Based on the level of training and proficiency in the use of firearms under a variety of circumstances and conditions, and the lack of past accidents, the likelihood for an incident involving any member of the public or a pet is negligible.

4.6.3.3 What are the Potential Risks to WS-Utah Field Employees from Using Firearms

A firearm "accident" is defined as an event resulting in injury or property damage, while an incident does not result in either injury or property damage.

The risk to WS-Utah field employee's health with the use of firearms and firearm-like devices ranges from minor incidents to potentially significant accidents. The most common potential risks involve bruises to the shoulder and face from firearm recoil, damage to hearing from sustained use without proper hearing protection, eye damage from ammunition debris upon firing, and accidental gunshot would from improper handling. Mechanical function of the firearm or defective ammunition could result in shrapnel, lacerations, punctures, or damage to eyes or limbs.

To protect hearing, in addition to using PPE when appropriate, APHIS-WS initiated a Hearing Conservation Program to minimize hearing loss and monitor employees subjected to frequent noise based on the applicable Occupational Safety and Health Administration Hearing Conservation guidelines (https://www.osha.gov/Publications/osha3074.pdf). This makes available hearing tests for employees exposed to eight hours of 85 dB or higher noise. Employees are required to wear adequate hearing protectors and be trained how to use them before working at harmful noise exposure thresholds. Periodic hearing tests for such employees are required to determine if hearing is being impaired.

Additionally precautions taken by APHIS-WS employees include knowing what is beyond targets, wearing eye protection, and storing firearms and ammunition so they are not accessible to unauthorized persons.

WS-Utah employees are highly familiar with the firearms they use, which ensures accuracy and safety. Nationwide, APHIS-WS employees have had 55 accidents with uses of all firearms between 2011 and 2015, average of 10.2 per year, typically by firearm and ammunition malfunctions (Table 4-14). Incidents due to operator error were minimal.

Lastly, since APHIS-WS field personnel operate firearms outdoors, they are not directly exposed to the low volume of particulates created by firing a firearm.

No accidents or incidents were recorded by WS-Utah involving firearms between FY 2011 and 2015, and an average of 10 were recorded nationwide in APHIS-WS. Although not identified specifically due to firearms, WS-Utah field employee accidents and resultant injuries overall are minimal.

With proper and repeated training per WS Directives 2.615 and 2.625, constant awareness, and proper use of PPE, accidents other than those caused by firearm and/or ammunition malfunctions can be and are mostly avoided, as indicated by data in Table 4-14. Therefore, few accidents and incidents during APHIS-WS and WS-Utah activities have occurred and the risk of injury is minor.

Table 4-14. APHIS-WS Nationwide Total and Average Record of Accidents and Incidents with Firearms and Firearm-like Devices during all WDM Activities, FY 2011-FY 2015.

Firearm[1]	Operator Error (ave.yr)	Mechanical Failure (ave./yr)	Ammunition Failure (ave./yr)	Mishap (ave./yr)	Injury (ave./yr)
Shotgun (ground)	1.0	1.0	0.8	-	0.2
Shotgun (aerial)	--	--	--	--	--
Rifle	0.8	3.2	1.0	--	0.2
Pistol	0.6	0.2	--	--	0.2
Air rifle	0.6	--	--	0.2	0.2
Cracker shell pyrotechnic	--	--	0.8	--	--
Paint balls, rubber bullets	--	--	-	--	--
Average Total	3.0	4.4	2.6	0.2	0.8

No accidents were recorded due to use of dart guns or other non-lethal projectiles

4.6.4 What are the Potential Impacts and Risks from the Use of Aircraft and Aerial PDM?

WS-Utah uses or contracts for fixed-wing aircraft and helicopters for intentional aerial PDM of coyotes on areas under agreement. In Utah, these activities occur primarily in late winter and early spring, during lambing and calving seasons, and the most commonly used aircraft are fixed-wing Piper PA-18 Super Cubs, Cub Crafters CC-18 Top Cubs; and rotary-wing Hughes 0H6. WS-Utah currently uses shotguns for aerial PDM, but some rifles may be used selectively in the future.

APHIS-WS has used aerial PDM for over sixty years, with no known adverse impacts on any native wildlife populations, nor are these anticipated in the future. APHIS-WS avoids other wildlife when observed during flying time. It is expected that WS-Utah aerial PDM and flights will not cause any long-term adverse impacts to non-target species, including those that are listed as threatened and endangered (April 2017 USFWS Biological Opinion). In addition, no unintentional take by WS-Utah has occurred between 2011 and 2015 during aerial PDM activities, and no humans on the ground have been injured as a result of a crash or during aerial PDM. Risks related to these activities are discussed in detail in the *WS Use of Aircraft in Wildlife Damage Management Risk Assessment* (WS 2017g).

4.6.4.1 What are the Potential Impacts on Wildlife from Low-level Overflights?

Low-level flight impacts to wildlife have been studied extensively, and this research has informed the APHIS-WS position on the potential effects of our aerial operations. Studies evaluated as part of this analysis included:

- Kushlan (1979): low-level overflights of 2-3 minutes by a fixed-wing airplane and a helicopter produced no drastic disturbance of tree-nesting colonial waterbirds
- Conomy et al. (1998): only 2% of wintering American black ducks, American wigeon, gadwall, and American green-winged teal (*Anas crecca carolinensis*) exposed to low-flying military aircraft reacted
- Delaney et al. (1999): 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 but were more prone to flush from chain saws.
- USFS (2002): Mexican spotted owls showed minor behavioral changes to F-16 training runs, but less than to natural and other man-made occurrences
- Andersen et al. (1989): red-tailed hawks habituate to low-level helicopter flights during the nesting period
- White and Thurow (1985): ferruginous hawks are sensitive to certain types of ground-based human disturbance. However, neither low-flying military jets nor fixed-wing aircraft within 100 feet impacted them
- Ellis (1981): five species of hawks, two falcons, and golden eagles were tolerant of overflights by military fighter jets; negative responses were brief and never limited productivity
- Grubb et al. (2010): golden eagles were not adversely affected by civilian and military helicopter flights in northern Utah

- Krausman et al. (1986): three of 70 observed mule deer responses to fixed-wing aircraft overflights at 150 to 500 feet above ground resulted in changing habitats, but they may have become accustomed to frequent aircraft activity in the area
- VerCauteren and Hygnstrom (2002): overflown deer typically stood up from beds, but did not flush
- Krausman and Hervert (1983): in 32 observations of responses 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
- Krausman et al. (1998): 14% of bighorn sheep had elevated heart rates that lasted up to 2 minutes after an F-16 overflight at 400 feet, but it did alter the behavior of penned bighorns.
- Weisenberger et al. (1996): desert bighorn sheep (*Ovis canadensis nelsoni*) and mule deer had elevated heart rates for 1 to 3 minutes and became alert for up to 6 minutes following exposure to jet aircraft.
- Fancy (1982): two of 59 bison groups reacted to fixed-wing aircraft flying at 200-500 feet above ground

APHIS-WS uses fixed- and rotary-wing aircraft for aerial WDM activities only in areas under agreement and concentrates efforts during certain times of the year such as during lambing. APHIS-WS annually flies less than 20 min/mi^2 (this is less than two seconds per acre), on properties under agreement. WS avoids non-target wildlife such as wild horses and sage-grouse lek sites. APHIS-WS concludes that disturbance effects to raptors, ungulates and other species are short-lived and negligible and will not cause adverse impacts to non-target species including those that are threatened or endangered. Risk assessment details are available in the *WS Use of Aircraft in Wildlife Damage Management Risk Assessment* (WS 2017g).

4.6.4.2 What Are the Potential Impacts of Aircraft Sound on the Public, Including Recreationists and Hunters?

The response of humans to noise depends on the frequency, intensity, duration, and fluctuations in sound pressure, personal perception, and atmospheric conditions (cold dense air transmits sound more readily than warm breezy air). The distance from the source of the noise and attenuation of the sound from buildings, vegetation, wind, humidity, and temperature also affects the level of perceived noise.

Hunters wearing Hunter Orange for safety would likely be visible to aerial crews, and could thereby be avoided to reduce all forms of risk including from noise. In addition, WS-Utah limits or avoids (when possible) aerial PDM during hunting seasons). These measures prevent or limit overlap between aerial PDM and recreational uses. When on public lands, WS-Utah is notified by public land managers, during Annual Planning meetings and at other times, of areas with high potential for recreational use.

Federal Aviation Administration rules require pilots to stay at least 500 feet from people or human made structures. It is feasible that a person may not be seen, but air and ground crews watch for people to avoid them. Most areas where WS-Utah conducts aerial PDM are sparsely vegetated and people are likely to be seen. In rare instances, people in the vicinity of aerial PDM activities are startled, but have not been within minimum safe distances.

4.6.4.3 What are the Potential Risks to the Health and Safety of WS-Utah Employees during Aerial Activities?

The use of firearms in aerial PDM has inherent dangers. APHIS-WS requires training and certification for employees to use firearms (WS Directive 2.615, Section 2.4 A3). Between 2000 and 2015, APHIS-WS recorded seven incidents involving firearms causing damage to the aircraft during aerial PDM (both directly shooting parts of the aircraft and shot ricochet from rocks on the ground), with the last incident occurring in 2010. However, no accidents or incidents related directly to shooting have been recorded for aerial PDM by WS-Utah over the last 10 years. Additionally, over the last 5 years, WS-Utah has had one non-fatal aerial incident with a helicopter due to mechanical failer.

WS-Utah believes the risk of accidents related to aerial PDM is minimal and less than that for general aviation. Details of evaluation of risk from aerial activities to WS employees are in the *WS Use of Aircraft in Wildlife Damage Management Risk Assessment* (WS 2017g).

4.6.4.4 What is the Potential for Wildlife or Hazardous Spills from an APHIS-WS Aircraft Crash?

The risk of fire or hazardous spills related to WS-Utah's aerial PDM program are considered negligible. In addition, the National Transportation Safety Board considers risks of fire and from hazardous spills related to government aircraft operations and accidents to be negligible nationwide (Norm Wiemeyer, Chief, Denver Field Office, NTSB, pers. comm.). Details on the evaluation of related risk can be found in the *WS Use of Aircraft in Wildlife Damage Management Risk Assessment (*WS 2017g).

4.6.4.5 What is the Potential for Compromised Physical Security of APHIS-WS Aircraft and Related Facilities?

WS-Utah personnel are trained to reduce the threat of theft or illicit activities associated with APHIS-WS or contracted aircraft. No aircraft either owned or contracted by APHIS-WS or WS-Utah has ever been stolen and the potential for such occurrences is considered negligible under all alternatives considered here. Details on how these risks were evaluated and addressed can be found in the *WS Use of Aircraft in Wildlife Damage Management Risk Assessment* (WS 2017g).

4.6.5 What are the Potential Impacts and Risks from the Use of Trained Animals?

A trained dog, as defined by WS Directive 2.445 (Section 2.4 A14) is a dog that is proficient in the skills necessary to perform specific functions in a manner responsive to its handler's commands by exhibiting the desired or intended behavior. Such dogs shall not pose a threat to humans or domestic animals or cause damage to property.

Trained dogs are used to track or trail animals, detect particular species or their sign, retrieve animals taken with another method such as firearms, haze animals from an area where they are not wanted such as birds in an air operating area, and decoy or attract coyotes which respond to canid invasions of their territories. Additionally, dogs, along with other animals, are sometimes used to guard and protect livestock from other predators.

Dogs may be owned by APHIS-WS personnel or by contractors hired by the agency and certified for use. The tracked or decoyed animal may be either euthanized or immobilized, depending on state law and management objectives. WS Directive 2.445 requires personnel to ensure that trained dogs have all the necessary care, including appropriate housing, food, and all required licenses and vaccinations per applicable state and local laws.

Details of the evaluation of risk from the use of pursuit dogs and livestock guard animals can be found in the *WS Use of Dogs in Wildlife Damage Management Risk Assessment* (WS 2018RA15).

4.6.5.1 What are the Potential Impacts of the Use of Trained Animals to the Environment?

Dogs in training or improperly trained dogs could pursue and harass non-target wildlife from the area.

Pursuant to the Migratory Bird Treaty Act, a dog handler cannot allow their dog to catch or harm protected migratory birds unless they are targeted and being harassed or retrieved by working dogs under the appropriate permit, if necessary. In some cases, a state permit may be required to harass wildlife using dogs. Handlers must especially consider the flightless period for birds or birds commonly on the ground feeding, nesting, or molting to ensure that dogs do not harass or kill them as easy targets.

To avoid stress and injury of the target animals from the resultant struggle to avoid a dog when restrained, the handler must exhibit a high level of respect and professionalism and control the dog from harassing or attacking the animal.

Complying with the requirements of WS Directive 2.445 results in the risk of injury to non-target animals or to restrained animals by use of trained dogs to be negligible. The dogs themselves are properly cared for at all times. Therefore risks are minimal.

4.6.5.2 What are the Potential Risks to the Health and Safety of WS-Utah Employees and the Public from the Use of Trained Animals?

To ensure proper control of the dogs, APHIS-WS personnel use various methods and equipment, such as muzzles, electronic training collars, harnesses, and leashes. In addition, APHIS-WS personnel are required to obtain appropriate licenses and vaccinations for their trained dogs in accordance with applicable state and local laws. When in appropriate settings such as an urban area, APHIS-WS dog handlers follow applicable leash laws when using trained dogs. These policies tend to minimize problems with dogs and potential to impact human health and safety.

No members of the public have been injured by trained dogs handled by APHIS-WS employees or by animals that were at bay or controlled by trained dogs for at least the last ten years. All employee bites were from ranch or feral dogs, not trained dogs.

Highly trained livestock guarding animals, such as dogs or llamas, are under the ownership, care, and control of the livestock owner or their agent. Activities of WS-Utah field personnel in investigating depredation events or conducting PDM activities may be in the vicinity of such animals and must take care not to distract or directly interact with them. They are trained to protect the livestock from all threats, including perceived threats from people, and are not socialized to human interactions.

The risk of injury to field employees or the public from trained dogs actively working in the field and under the control of handlers, as well as livestock guarding animals, is negligible.

4.6.5.3 What are the Overall Environmental Impacts and Health and Safety Risks Associated with the Use of Trained Animals?

WS-Utah field personnel experienced in the use of trained dogs, or currently using them, are required to protect both themselves and their dogs. WS-Utah personnel are also experienced with the training and behavior of valuable livestock guarding animals, and are careful to protect themselves and the animals. The impacts and risks are negligible for both employees and animals under all alternatives involving WS-Utah field activities associated with livestock or the use of pursuit dogs for trailing or capturing predators.

For alternatives involving non-WS-Utah field personnel, risks and impacts associated with the use of trained dogs would likely be similar, since owners of such trained and valuable dogs are experienced. However, non-WS-Utah entities hired by landowners may not be experienced with conducting activities near livestock guarding animals and may be injured or inadvertently injure the animal. This could occur for any alternative in which WS-Utah activities are restricted.

4.6.5.4 What are the Comparative Impacts of the Alternatives from the Use of Physical/Mechanical Methods?

Alternative 1. Proposed Action/ No Action Alternative: Continue WS-Utah PDM Program

The analysis for impacts on soil, water, terrestrial, and aquatic species indicates little to no effect on the environment from the use of any physical capture devices, shooting, aerial PDM, trained animals. The impacts from lead will be discussed in (Section 4.6.6).

Impacts or risks to human health and safety, including recreationists and hunters, and domestic livestock are very low on private lands. Additionally, impacts or risks to humans and domestic animals are highly unlikely on public lands due to the very low potential to encounter equipment set, WS-Utah employees have a high level of proficiency and are routinely trained in the use of mechanical methods. WS-Utah employees always follow APHIS-WS Directives and other protective measures, including the use of PPE and safety requirements, which substantially reduces the risk of major or minor injuries during PDM activities.

The time flying over a particular area on any one day is relatively short. WS-Utah has actively used or contracted fixed-wing aircraft and some helicopters for aerial PDM in areas inhabited by wildlife for many years. The fixed-wing aircraft used by WS-Utah and its contractors are relatively quiet, whereas helicopters are somewhat noisier because of the impulses from the rotary blades. WS-Utah conducts IPDM activities on areas only under agreement, and concentrates efforts during certain times of the year, typically in the late winter and early spring during livestock lambing and calving. When aerial PDM on public lands, WS-Utah minimizes low level flight time during hunting seasons or other times when the public are anticipated to be present. Based on the above information and analysis, it is reasonable to conclude that WS-Utah aerial PDM low-level flights should not have foreseeable effects on humans, domestic animals, and the environment.

Alternative 2. WS-Utah Provides Operational Lethal Strategies for corrective PDM Only

Under this alternative, WS-Utah would provide non-lethal and lethal corrective assistance. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities. With this alternative, WS-Utah would use the APHIS-WS Decision Model for providing advice and technical assistance, as well as training on identification of species, and possibly individual animals, causing damage. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available, or attempt to address their PDM needs themselves.

Relatively few WCOs are available for large predator damage management, but landowners can request someone to work as their agent. Private individuals are not likely to have the consistent experience with lethal methods and or the knowledge to confirm the cause of damage, or the level of selectivity possessed by WS-Utah employees. WCO may not have the experience or response capability with some of the species and methods if they are not already conducting IDPM activities for those particular species Both private individuals and WCO may not have the specific initial and reoccurring training for firearm, aerial PDM, and other methods that WS-Utah implements for its employees. The consistent use of PPE by private entities is likely to be lower than that used by WS-Utah employees. The level of accidents and risk of injury may be higher for private individuals and landowners who are not proficient or experienced with the use of many of the physical/mechanical methods. If opting for aerial PDM, private individuals may spend more time flying over an area or implementing PDM methods.

There is a potential for other entities to attempt to fill the void of lethal IPDM activities in the absence of lethal operational assistance from WS-Utah. Since it is likely that most lethal methods used by private entities would be conducted on private land, there is low likelihood that recreationists and hunters would encounter equipment placed by landowners or their agents. Other commercial, governmental, and private entities and landowners would be expected to continue to conduct PDM activities. However, depending on the skillset of other entities in minimizing the risks to humans, domestic animals, and the environment, effects could be greater than, less than, or similar to those under Alternative 1. It is possible that people, domestic animals, and the environment may have fewer exposures to PDM methods in the absence of lethal operational assistance from WS-Utah because there may be fewer entities readily available to help address conflicts, and because individuals experiencing damage may not take action themselves. Conversely, people and domestic animals could be exposed to an increase in PDM methods and activities by other entities as a result of increased and less selective PDM efforts. While WS-Utah would still be available for lethal corrective assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual’s lack of experience and proficiency.

Therefore, WS-Utah’s actions under Alternative 2 would be similar to Alternative 1 for technical assistance and nonlethal PDM. WS-Utah’s overall risks and adverse effects on humans, domestic animals, and the environment would be less since WS-Utah would not conduct any preventative lethal activities. However, in the absence of WS-Utah’s lethal IPDM activities, other entities may present more risks and adverse effects on humans and domestic animals, but effects on the environment are expected to be similar to Alternative 1.

Alternative 3. WS-Utah Provides Non-lethal Damage Management Only

Under Alternative 3, WS-Utah would provide technical and operational assistance for non-lethal activities. Non-lethal methods would not likely cause impacts to humans, domestic animals, or the environment. The APHIS-WS Decision Model may not be fully effective because lethal actions could not be used by WS-Utah during the time that non-lethal methods are attempted to address the immediate problems. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities.

During (or instead of) WS-Utah's non-lethal assistance, landowners could still choose to address the problem by implementing lethal methods before applying all reasonable non-lethal methods. The landowner could use trained and experienced WCOs or may implement lethal methods themselves. Other entities could increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-Utah.

However, similar to Alternative 2, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available. Assuming that commercial WCOs are experienced and proficient, effects of mechanical methods on the environment or their safety are probably low. However, landowners or other private entities would potentially have less proficiency, and therefore safety, as discussed in section 4.6.

Therefore, WS-Utah's actions under Alternative 3 would have lees of an effect on humans, domestic animals, and the environment with nonlethal technical assistance and operational damage management. However, other entities may pose a greater risk to humans and domestic animals, but impacts on the environment are expected to be similar to Alternative 1.

Alternative 4. WS-Utah Provides Technical Assistance Only

Under Alternative 4, WS-Utah would provide full PDM technical assistance (Appendix E). WS-Utah could not use lethal methods as part of IPDM to respond to requests (e.g., agriculture, property, and game species). Because operational lethal actions would not be available to manage damage to resources, however, other commercial, governmental, and private entities and landowners would continue to conduct or increase their PDM activities.

Since WS-Utah would not be able to respond with lethal methods to damage or threats to any other resources or situations, the impacts would likely be similar to Alternative 3. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-Utah.

Additionally, private individuals are not likely to have the consistent training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-Utah employees, as discussed under Alternative 2 and 3, increasing the-effects to humans, domestic animals, and the environment. The impacts to the environment would be similar to those discussed under Alternative 1.

Therefore, WS-Utah's actions under Alternative 4 would be similar to Alternative 1 for technical assistance. Overall effects on humans, domestic animals, and the environment would be less since WS-Utah will not be using physical/mechanical lethal methods. However, in the absence of WS-Utah's lethal IPDM activities, other entities may have more impacts on humans and domestic animals, but impacts to the environment are expected to be similar to Alternative 1.

4.6.6 What are the Potential Impacts and Risks from the Use of Lead Ammunition?

Agencies and members of the public have expressed concerns regarding the potential for adverse environmental impacts and risks to human and wildlife health and safety and environmental contamination from the use of lead ammunition by APHIS-WS.

Exposures to lead for humans and the environment have been from, and in some cases continue to be from, lead additives in gasoline and paint, use in drinking water pipes and plumbing, coal-fired power plants, construction and demolition, lead-acid batteries, jewelry and leaded windows, lead-coated toys, and individual activities such as cigarette smoke and home renovations. The primary transport is through air emissions and subsequent deposition into soils and surface waters, and through hand-to-mouth transmission and drinking contaminated tap water, especially with children (lead paint chips, toys, and contaminated soils). With the phase-out of lead-based paint (phased out in the US in the 1970s) and tetraethyl lead in gasoline (phased out in the US between 1986 and 1991), the primary sources today are lead-acid batteries, lead-based chemicals, and to a lesser extent, construction materials. Lead poisoning has been documented in humans for at least 2,500 years, and in waterfowl from spent lead for over 100 years (Golden et al. 2016). Metallic lead released into the environment can be readily released for transport through the environment and bio-accumulated into living plants and beings when fragmented into small pieces or under strong acidic conditions in water, soils, or digestive systems (Golden et al. 2016, TWS 2009).

Efforts to reduce environmental concentrations of lead, predominantly through phasing out the use of leaded gasoline, have resulted in substantial decreases in the introduction of lead into the environment (IARC 2006). Lead, however, is retained in soils and sediments, where it can be stable and intact for long periods of time, re-suspended and re-deposited multiple times before further transport becomes unlikely, and released for transport through environmental and biological systems under certain conditions (EPA 2013).

Additional, but more substantially smaller and more localized sources of lead in the environment and human exposure involve the use of leaded ammunition and fishing sinkers. Bullets and sinkers can be directly introduced into the terrestrial and freshwater environment, where it can potentially be transported, and to humans through ingestion of game meat shot with leaded ammunition (TWS 2009).

Further detail on risk associated with the use of lead ammunition may be found in the *WS Use of Lead in Wildlife Damage Management Risk Assessment* (WS 2018RA12).

Background

An average lead shotgun shot or pellet contains 97% metallic lead and jacketed bullets contain up to 90% metallic lead (Tanskanen et al. 1991, Scheuhammer and Norris 1995, Scheetz and Rimstidt 2009). The amount of lead in ammunition varies based on the type of firearm; the size and weight (pellet grain) of the shell, shot, bullet, or pellet; the shotgun gauge or bullet caliber; and the physical length of the shell used (and therefore the number of pellets incorporated).

An important environmental concern for lead ammunition is its high frangibility (the tendency of a lead pellet or bullet to break up into small fragments once it strikes tissue or hard surfaces). When a lead bullet (which is not entirely encapsulated by other metals) strikes tissue, it quickly begins to expand and break up into tiny pieces as it continues through the tissue. Gutpiles that are left behind in the field are typically contaminated with lead fragments, and lead has been recovered from game meat shot with lead ammunition (NPS, viewed March 2016).

Lead can cause a variety of adverse health and physiological effects in people, terrestrial wildlife, aquatic organisms, and plants (IARC 2006, ATSDR 2016, EPA 2013, Golden et al. 2016). Effects of lead exposure can have rapid onset and be caused by just one exposure (acute, such as ingesting one or more pellets at one feeding to susceptible organisms) or can occur chronically (multiple exposures over time, such as ingesting multiple meals made up of meat or gut piles with lead fragments). During pregnancy, lead is transferred from the mother's bones to the fetus and to the baby through the mother's milk. Lead also can attach to red blood cells and be carried in the plasma (EPA 2013). Lead can affect reproduction, the nervous system (including the brain), the heart, fetal and juvenile development, and behavior in humans and other vertebrates, with fetuses and children especially susceptible (IARC 2006, ATSDR 2016, EPA 2013).

Waterfowl, raptors, and scavenging birds are especially subject to lead poisoning from leaded ammunition. Waterfowl pick up shot pellets from feeding on the bottom of lakes and ponds; raptors and scavenging birds ingest it from wounded and dead game animals and gut piles left in the field. Birds with gizzards grind the lead into very small fragments, making it more active. Carnivorous birds have highly acidic stomachs, which also make the lead more physiologically active (Golden 2016).

The US Fish and Wildlife Service has banned the use of lead shot in waterfowl hunting since 1991, phased in beginning in 1986 (Golden et al. 2016).

On January 19, 2017, the USFWS expanded their policy on the use of leaded ammunition on National Wildlife refuges through USFWS Director's Order No. 219, which mandated the use of non-lead ammunition for management and research activities on national wildlife refuges (601 FW 8; https://www.fws.gov/policy/601fw8.html). As of March 2, 2017, the U.S. Secretary of the Interior issued Secretary's Order No. 3346 which revoked USFWS Director's Order No. 219. The Secretary's Order cited that the USFWS order was "not mandated by any existing statutory or regulatory requirement and was issued without significant communication, consultation, or coordination with affected stakeholders" (https://www.doi.gov/sites/doi.gov/files/uploads/order_no._3346.pdf).

Subsequent to the 2008 ban on use of leaded ammunition when hunting in an area designated as California condor range, California required the use of non-lead ammunition when taking any wildlife with a firearm, including under depredation permits in 2013, with regulations in place by 2015 and full implementation of the ban for taking wildlife by 2019. Arizona has a voluntary switched to non-lead ammunition for hunters within Arizona portion of the condor range.

Additionally, Arizona has provided discounted non-lead ammunition to big game hunters within condor range since 2005, as well as a gut pile raffle for encouraging removal of gut piles from the field when lead ammunition was used (http://www.azgfd.gov/w_c/california_condor_lead.shtml). Other states have passed various bans on the use of lead-based ammunition for upland game birds, specified migratory birds, and in special-designation areas, in addition to federal regulations (http://www.leadfreehunting.com/state-regulations/). UDWR requires non-leaded ammunition for waterfowl on state WMA's and regulated hunt areas.

Ground and aerial PDM are critical components of APHIS-WS activities. APHIS-WS uses firearms including various caliber rifles, pistols, air guns, and shotguns, depending on the target animal and site conditions, for ground-based, aerial, and harassment shooting, and shooting to euthanize animals caught in traps. The APHIS-WS program has specific ammunition and firearm requirements to maximize performance (accuracy and conveying its full energy to the target and resulting in low or no pass-through), safety, and humaneness (shot placement to result in rapid death) (Caudell et al. 2012). Direction of ricochet/pass-through is difficult to predict and is a safety concern, especially at airports, in areas near residences, areas with rocky substrate, and for APHIS-WS personnel in aerial PDM teams. When shooting animals from aircraft, shooters target the space directly behind the animal's ear, and the ammunition must be able to penetrate the thick skin located in this region. The objective of field personnel is to use the fewest number of shots on a particular targeted animal, with the intent of a clean kill with one shot.

Use of leaded ammunition by APHIS-WS is expected to continue to decline as non-leaded ammunition continues to increases in availability and effectiveness, and decrease in cost. Cooperators may be unwilling to pay any additional costs associated with some non-leaded ammunition where it is otherwise legal to use leaded ammunition. Landowners, land managers, state wildlife management agencies, and federal/state land management agencies continue to have the option to limit the use of leaded ammunition on their property, and APHIS-WS works with those entities to determine an acceptable wildlife damage management plan to meet objectives while minimizing or avoiding the use of lead-based ammunition when practicable. Periodic proficiency training received by WS-Utah's employees in firearm use and accuracy increases the likelihood that animals are harvested humanely with clean and humane kills and infrequent misses, using the minimum amount of ammunition (WS Directive 2.615, Section 2.4 A3-d).

For all programs, APHIS-WS uses lead-free ammunition when practical, effective, and available to mitigate and/or minimize the effects of its use of lead ammunition on the environment, wildlife, and public health and in compliance with federal, state, territory or tribal regulations on the use of lead ammunition. APHIS-WS evaluates new lead-free ammunition options as they become available. As a federal agency, APHIS takes a cautious approach to ensuring that adverse program effects are minimized by complying not only with applicable federal laws, but also with state and local laws and regulations for the protection of the environment. Further, WS-Utah adheres to landowner and land manager agreements (Directive 2.210) , and therefore would not use lead ammunition in any location where it was so specified within the agreement.

Inorganic (metallic) lead used in ammunition has been analyzed by multiple agencies and entities in terms of its impacts on humans and the environment.

The US Environmental Protection Agency has developed several scientific analyses regarding toxic chemicals and their effects on humans and the environment, including for lead, which were referenced in this analysis.

- **Ecological Soil Screening Levels for Lead (Eco-SSL), 2005 (Interim Final):** EPA (2005) established ecological soil screening levels (Eco-SSL) that can be used as an effect threshold based on the available toxicity data. The Eco-SSLs are concentrations of contaminants in soil that are protective of various ecological resources that commonly come into contact with and/or consume biota that live in or on soil.
- Integrated Science Assessment (ISA) for Lead: EPA (2013) conducted a very detailed assessment of the sources of lead and the relative potential for lead to have a causal relationship to effects on human health and the environment.
- Integrated Risk Assessment System (IRAS) for Lead: This EPA (2004) database system provides detailed human health assessment information, including carcinogenicity, for potentially toxic compounds, including inorganic lead, for chronic exposure, including recognition that humans are typically cumulatively exposed from multiple sources.

Additional pertinent analyses used in the analysis include:

- International Agency for Research on Cancer (IARC): IARC (2006) issued an analysis for cancer risk in humans potentially associated with lead. This monograph evaluates the sources of inorganic lead, methods of human exposure, and toxic effects, especially related to its carcinogenicity in humans.
- Agency for Toxic Substances and Disease Registry (ATSDR) Lead Toxicity (last updated 2016): This review states the US standards for lead levels.
- Golden et al. (2016): This publication is a detailed review and assessment of spent lead ammunition and its exposure and effects on scavenging birds in the United States. This comprehensive review of the literature regarding the potential effects of lead ammunition on birds, with a focus on scavenging birds provides the most current data and interpretations, including an analysis of alternative non-lead ammunition approved by the USFWS. Source documents not otherwise cited can be readily obtained from this publication.
- The National Park Service website summarizes recent findings and provides links to many original papers and conference proceedings related to the effects of lead on birds (http://www.nps.gov/pinn/learn/nature/leadinfo.htm (cited as: NPS, viewed March 2016). Source documents not otherwise cited can be readily obtained from links on this website.

Environmental impacts and risk to human health and safety from the use of firearms are analyzed in (Section 4.6.3)

Inorganic lead is not a natural component of any biological system, and can affect many different components of the environment, including people. It is clear from a review of the documents above that most of the human health and environmental impacts associated with lead are caused by sources of lead other than lead ammunition, including the comparatively small amount of lead ammunition used by APHIS-WS and WS-Utah during wildlife and predator damage management activities. The primary safety and health concerns with lead is caused by lead ingested by individual scavenging birds that feed on a shot carcass, crippled animals, and/or gutpiles left in the field (Section 4.6.6), and human ingestion of game meat shot with lead ammunition Section 4.6.6.5).

4.6.6.1 What is the Environmental Fate of lead and its' Exposure through Soil and Water Media and Uptake by Terrestrial and Freshwater Plants?

Lead can be introduced to soil and water through WS-Utah PDM activities from an animal being fatally wounded in an aquatic environment and the body not retrieved, directly from ammunition being discharged into aquatic areas, or shooting predators on land, either by leaving the carcass in the field or the lead passing through the animal.

Lead fragments may be moved physically through water and soil based on the velocity/volume of water, the slope steepness, soil type, and vegetation obstacles. Chemically, lead oxidizes when exposed to air and dissolves and goes into solution when exposed to acidic water or soil, where it can then move through soil and into groundwater and surface water. 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 8 inches.

A representative average weight of soil is in the range of 110 pounds per cubic foot (Environmental Working Group 2001). The number of cubic feet of soil in the top eight inches in one acre is about 29,000 cubic feet. Therefore, a reasonable estimate of the total weight of the top layer of soil per acre where spent lead shot should remain would be 3.2 million pounds (110 x 29,000).

Average lead use in WS programs is approximately 11,249 pounds or approximately 5 metric tons per year. The amount of lead released into the environment from APHIS-WS activities is orders of magnitude below the total amount currently being released into the environment in the United States due to hunting, fishing and industrial activities.

Impacts of lead to soils, water, and plants from WS-Utah activities are expected to be negligible.

4.6.6.2 What are the Impacts of Lead on Freshwater and Terrestrial Invertebrates, Amphibians, Reptiles, and Fish?

Exposure to lead at sufficient levels can reduce reproduction and growth, especially in freshwater invertebrates. Lead exposure can also affect behavior in vertebrates, such as limiting the ability to avoid and escape predators, find and capture food, and behavioral regulation of body temperature. Physiological markers for stress have also been found in plants, invertebrates and vertebrates, potentially increasing susceptibility to other environmental stressors. Terrestrial and aquatic organisms respond according to the gradient of increasing concentrations of lead. Effects on the reproduction, growth, and survival in sensitive freshwater invertebrates are well characterized from controlled studies at concentrations at or near lead concentrations occasionally encountered in US fresh surface waters. However, in natural environments, factors such as pH and organic matter composition modify and reduce the bioavailability and toxicity of lead. Most studies of the effects of lead at the community and ecosystem levels are from highly contaminated areas where concentrations are substantially higher than typically encountered in the environment.

Although lead from spent ammunition and lost fishing tackle is not readily released into aquatic and terrestrial systems, under acidic environmental conditions it can slowly dissolve and enter groundwater. Risks of this type of impact are greatest near some shooting ranges and at heavily hunted sites, particularly those hunted year after year, and under acidic water and soil conditions with low levels of organic matter. Lead can especially concentrate in aquatic filter feeders and algae (Eisler 1988).

A majority of the published literature regarding the impacts of lead on terrestrial invertebrates focuses on the potential residues that could occur in these organisms in areas that are adjacent to industries related to lead use or production. EPA (2005a) established ecological soil screening levels (Eco-SSL) that can be used as an effect threshold based on the available toxicity data. The Eco-SSL in this case was based on the geometric mean of the maximum allowable toxicant concentration (MATC) using the collembolan (*Folsomia candida;* a small insect-like organism that lives in soil) and reproduction as the endpoint. The value estimated from these studies was 1,700 ppm dry weight (dw). Soil pH ranged from 4.5 to 6.0 (relatively acidic) with an organic matter content of 10% in all studies. Other toxicity studies assessing lead effects on nematodes (small worm-like organisms that live in the soil) and earthworms did not meet the criteria for estimating the Eco-SSL but still provide information regarding lead sensitivity for other soil-borne terrestrial invertebrates. In these studies, median lethality values for the nematode (*Caenorhabditis elegans*) ranged from 11.6 to 1,434 ppm dry weight (dw) with higher toxicity at lower pH (acidic) and organic matter values. Median lethality for the earthworm (*Eisenia fetida*) was reported at 3,716 ppm dw with reproductive effects noted between 1,629 and 1,940 ppm dw.

Effects from lead shot have been observed in reptiles, especially from chronic exposures. Lance et al. (2006) reported reproductive impacts on captive American alligators (*Alligator mississippiensis*) that were fed nutria containing lead shot. This supports previous work regarding the detection of lead in captive alligators that were related to ingestion of nutria containing lead shot (Camus 1998). Lead blood levels of 0.28 ppm with no apparent lead toxicosis suggest that reptiles may be less sensitive to the effects of lead. Hammerton et al. (2003) made similar observations with the estuarine crocodiles (*Crocodylus porosus*) that had high lead blood levels from consuming prey contaminated with lead ammunition.

Sub-lethal lead exposures can impact multiple physiological and biochemical functions in aquatic vertebrates that can lead to reduced reproduction and growth, and the inability to avoid predators and forage for prey items (Eisler 1988). Median lethality values for amphibians range in the low part per million to greater than 12.5 ppm in pore water, or water occupying the spaces between particles in sediment, for the northern leopard frog (*Lithobates pipiens*), while no observable effect concentrations were reported as low as 0.01 ppm (Eisler 1988, Chen et al. 2006). Adverse effects on fish occur at concentrations ranging from 0.0035 ppm to 29 ppm, with coldwater species such as the rainbow trout (*Onchorhynchus mykiss*) being one of the more sensitive species to the effects of lead (Eisler 1988). Based on available data, it appears that the range of fish sensitivity appears similar to the range of sensitivities for amphibians (Eisler 1988).

Risk to aquatic ecosystems is expected to be minimal based on the available toxicity data for lead, the potential exposure pathways, and low environmental fate and transport for lead. Risk to aquatic ecosystems including fish, amphibians, invertebrates and plants will occur primarily as lead ammunition either degrades in soil and is transported via runoff, or is directly deposited.

Lead levels estimated from APHIS-WS activities based on conservative assumptions of exposure would not exceed toxicity levels for aquatic non-target organisms. In addition, risk to aquatic ecosystems is further reduced as APHIS-WS transitions to non-lead ammunition where it is feasible to do so. With approximately 64% of the state APHIS-WS programs using less than 20% lead ammunition, exposure and risk of lead to aquatic organisms such as fish and aquatic invertebrates is expected to be negligible. The long half-life of lead ammunition in water, soil, and sediment combined with the minor amounts of lead that would be used in the program reduce the potential for significant water exposure from lead discharged directly into aquatic systems or from runoff from soil where lead ammunition may be present (Jørgensen and Willems 1987, EPA 2005a).

Exposure by animals eating plants with lead would not be considered a potential exposure pathway, since the lead is sequestered in roots. Lead uptake in plants and various prey items have been shown to occur; however, the low amounts of lead ammunition that are being used by WS-Utah in any one location and the lack of bioavailability to plants and other prey items suggest this exposure pathway to terrestrial vertebrates is negligible, with or without further transition to non-leaded ammunition.

Overall, the potential for lead from WS-Utah wildlife damage management in general and predator damage management activities in particular to cause negative impacts to terrestrial and freshwater invertebrates, amphibians, and fish is negligible.

4.6.6.3 What are the Impacts of Lead on Migratory, Carnivorous, and Scavenging Birds?

APHIS-WS has a Memorandum of Understanding with the USFWS pursuant to EO 13186 in which APHIS commits to "evaluate a reasonable range of alternatives in environmental reviews to avoid and minimize adverse effects to migratory birds...". USFWS interprets this to mean that APHIS-WS has an obligation to analyze, through NEPA, the potential effects of its programs on migratory birds and implement reasonable measures to conserve avian species protected by MBTA.

Bird sensitivity to lead from dietary exposure to leaded ammunition such as lead shot, bullets, or bullet fragments has been extensively studied and documented (see Golden et al. 2016 for a comprehensive analysis of the literature; Golden et al. 2016 is used extensively in this summary). Birds are especially sensitive to direct lead poisoning from ingestion because seed-eating birds that may pick up grains of ammunition-sourced lead from the ground have strong gizzards that grind the lead into small fragments, creating greater surface area. Meat-eating birds have strongly acidic stomach digestion conditions that cause the lead to be more bioavailable once it enters the bloodstream through the intestinal tract. Since lead can cause live prey to behave abnormally, contaminated prey may be more easily captured. Carcasses, gut piles, and crippled prey contaminated with lead are readily available sources of lead for scavenging birds in the field, of which many may feed on an individual carcass over time, getting a chronic and possibly lethal load of lead. Scavenging bird species include condors and vultures (exclusively scavengers), bald and golden eagles (both scavengers and meat eaters), and crows and ravens (which both scavenge and eat other meat and non-meat foods); hawks may also scavenge as the opportunity arises (Golden et al. 2016).

Lead poisoning is typically a chronic condition resulting in anorexia, loss of fat reserves, muscle wasting, wing droop, green-stained feces and cloaca due to bile staining, reluctance to fly or inability to sustain flight (causing people to think they have been crippled during the hunting season), and overall debilitation and weakness. Severely affected birds often do not have an escape response but will usually seek isolation and cover, making them difficult to find (Golden et al. 2016, NPS, reviewed March 2016).

Clinical signs of lead poisoning in birds are observed when blood lead concentrations reach 0.2 to 0.5 ppm, while severe clinical signs are observed at concentrations exceeding 1.0 ppm. (NPS, reviewed March 2016).

Pain et al. (2009), in a review regarding the impacts of lead shot and bullets on terrestrial birds, documented impacts on 33 raptor species and 30 other species including, but not limited to, raptors, ground nesting birds, cranes, and upland game birds. Lead impacts from spent ammunition have also been noted in numerous waterfowl species (Tranel and Kimmel 2009). An individual lead pellet has been shown to result in lead toxicosis in waterfowl and ground nesting birds, with as little as 10 pellets resulting in lethal and sub-lethal impacts on large raptor species such as the bald eagle, *Haliaeetus leucocephalus* (Eisler 1988). Therefore, the contribution of lead to impacts on carnivorous, migratory, and scavenging birds would be at the individual bird level, based on the baseline lead load that the bird already has from the environment. The baseline lead load would determine the degree to which lead consumed from the low level of lead ammunition used across the landscape would contribute to adverse health effects on an individual bird.

Cruz-Martinez et al. (2012) evaluated data on 1,277 bald eagles admitted to the University of Minnesota Raptor Rehabilitation Center from January 1966 to December 2009. Of these, 334 were identified as elevated lead cases (322 live, 12 dead). The researchers detected significantly increased odds for elevated lead levels based on season (late fall and early winter), deer hunting rifle zone, and age of bird (adult birds), with higher levels of lead in hunting zones using rifles versus shotguns. The difference was attributed to the fact that rifle lead bullets are more likely to fragment into small pieces that would be more readily ingested by eagles. Similar seasonal patterns in lead exposure corresponding with hunting season have been reported for ravens (Craighead and Bedrosian 2008).

Over the past three decades, California condor recovery efforts have clearly demonstrated how this lead pathway in the ecosystem can threaten even the very survival of a species. Semi-annual test results show that the majority of free-flying condors at Pinnacles National Park in Central California have blood lead levels that exceed 0.1 ppm, which is the same used by the Center for Disease Control as an initial warning sign that a human child is at risk (CDC 2014). Some condors have been measured with blood lead levels as high as 5.7 ppm, a value that would potentially kill a human. By the time condors at Pinnacles reach breeding age of 7 years old, almost all of them have received emergency, life-saving chelation treatment at least once. Numerous condors in the flock have now required multiple chelation cycles. Because condors only feed on dead animals and are group feeders, even small amounts of lead can sicken or kill many condors. Also, since all of their meals come from dead animals, condors are more frequently exposed to lead bullet hazards than most wildlife (NPS, reviewed March 2016).

Despite apparent success from the ban on the use of lead shot for hunting waterfowl in North America in 1991, upland game birds (which pick up lead particles with gravel for their crop) and scavenging birds continue to be exposed to lead shot.

At least two studies have indicated that the ban on the use of lead shot for hunting waterfowl in North America in 1991 has been successful in reducing lead exposure in waterfowl. Other studies have found that upland game, like doves and quail, and scavenging birds, such as vultures and eagles, continue to be exposed to lead shot, putting some populations (California condors in particular) at risk of lead poisoning. From 1983 through 1985, the U.S. Fish and Wildlife Service conducted a nationwide monitoring program for lead exposure in waterfowl. Samples from more than 8,000 waterfowl were collected on National Wildlife Refuges and analyzed at the National Wildlife Health Center. During the first two years of monitoring, the prevalence of ingested lead shot was highest in diving ducks at nearly 10%, with lower frequencies in dabbling ducks, geese, and swans. The study provided data that addressed phase-in criteria for nontoxic shot zones, but the impetus for the implementation of the nationwide ban on lead shot for waterfowl hunting was lead poisoning of bald eagles (NPS, viewed March 2016).

At the current rates of use by APHIS-WS and WS-Utah, lead ammunition may have the potential to adversely impact individual non-target birds, particularly birds which scavenge carcasses left in the field or which may inadvertently pick up lead shot when seeking grit for their crop. However, APHIS-WS total program use of lead ammunition is only a small fraction of lead ammunition used by other entities for activities such as hunting and target shooting. APHIS-WS adheres to all applicable laws governing the use of lead ammunition in APHIS-WS activities and landowner/manager desires for lead-free ammunition in their projects.

Additionally, the APHIS-WS program is shifting to lead-free ammunition as new lead-free alternatives that meet WS standards for safety, performance, and humaneness become reliably and cost-effectively available in adequate quantities for program use. Use of lead ammunition by APHIS-WS activities is decreasing over time. The potential for lead exposure and risk to these types of scavengers is reduced in situations where carcasses are removed or otherwise rendered inaccessible to scavengers through burial (such as for feral swine, not predators) or state, territory, or tribally approved carcass disposal practices. Consequently, cumulative impacts of APHIS-WS use of lead ammunition would be very low.

4.6.6.4 What are the Impacts of Lead on Terrestrial Mammals?

Studies evaluating the lead burdens in bodies of mammals that forage in areas contaminated by lead from industrial sources have revealed that lead has the potential for adverse effects on a variety of small and large mammal species (The Wildlife Society 2009).

The potential for effects on wild and domestic mammals from APHIS-WS activities would be the greatest for mammals that scavenge carcasses containing lead ammunition or that eat crippled animals or gut piles left in the field. Impacts of lead ammunition on populations of scavenging mammals are less clear than studies related to industrial sources of lead. Rogers et al. (2011) investigated blood lead levels in large carnivores (grizzly bears, black bears; gray wolves, and mountain lions in the Yellowstone ecosystem to determine if lead levels varied during hunting season. They did not detect a spike in blood lead levels during the fall hunting season typical of lead ammunition ingestion. However, while bears, particularly grizzly bears, exhibited elevated blood lead levels, blood lead levels were low for mountain lions and wolves. Observed patterns of blood lead levels in bears (particularly grizzly bears) may have resulted from a variety of factors, such as indirect lead exposure from other environmental sources such as mine tailings, exposure to carcasses of smaller animals such as rodents shot throughout the year and left in the field, or differences in the physiology of the bears.

Mammals exhibit similar physiological, physical, and behavioral responses to chronic lead poisoning as humans, which are discussed in (Section 4.6.6.4). The potential for lead exposure and risk to these types of scavengers is reduced when carcasses are removed and safely disposed of by WS personnel. The current use of non-lead ammunition by APHIS-WS and WS-Utah, when practical, and the transition to effective non-lead alternatives when available and cost-effective, further reduces the risk of lead exposure through these exposure pathways.

4.6.6.5 What are the Risks of Lead to Human Health?

Humans can be exposed to lead through ingesting or breathing lead-based paint chips or particles, inhaling air-borne lead, drinking water contaminated with lead, eating root plants, being exposed to soil contaminated with lead, and eating meat containing lead fragments, as well as other pathways (EPA 2005a).

Lead can cause long-term effects in children whose bodies absorb lead more efficiently, at levels as low as 0.1 ppm. Lead can be transferred from the mother to the fetus through chelating lead from the mother's skeleton via the blood and from the mother to infants via maternal milk. The elimination half-lives for inorganic lead in blood and bone are approximately 30 days and 27 years, respectively (IARC 2005, EPA 2013, ATSDR 2016).

The primary risks of human exposure to lead from APHIS-WS actions would be through the consumption of lead ammunition fragments in animal meat. Studies are increasingly showing that lead fragments can be widely dispersed in wild game meat processed for human consumption, even though best attempts are made in the field to remove sections that are within the bullet wound channel (for example, Pain et al. 2010; NPS, viewed March 2016; Golden et al. 2016).

Rapid-expanding ballistic tip lead bullets had the highest fragmentation rate compared with the shotgun slug and muzzleloader bullet, with an average of 141 lead fragments per carcass and an average maximum distance of 11 inches from the wound channel (Cornicelli and Grund 2009). Another study shows that humans can be exposed to bioavailable lead from bullet fragments through consumption of deer killed with standard lead-based rifle bullets and processed under normal procedures (Hunt et al. 2009, NPS, viewed March 2016).

Potential dietary exposure from APHIS-WS activities is unlikely, as most carcasses are retrieved for proper disposal, where feasible, and, even if not retrieved in the field, are unlikely to be consumed by humans. APHIS-WS may participate in donation programs such as "Sportsmen Against Hunger" whereby meat is donated under WS Policy 2.510. However, only meat that is processed professionally or by the carcass recipient is donated. Hematomas tend to be cut out to avoid lead fragments and foul tasting meat (much of the edible meat donated by APHIS-WS, such as from geese, is euthanized with CO_2, not lead or chemicals). In APHIS-WS activities, lead exposure from inhalation of lead fumes and dust during firing is minimal because shooting occurs outdoors as opposed to within enclosed firing ranges.

Although lead can be toxic to humans, the low potential for exposure to small amounts of lead released into the environment due to APHIS-WS activities nationwide (approximately 0.0017% of the lead released into the environment from hunting) suggests that adverse health risk from human exposure to lead in the environment from WS-Utah activities is highly unlikely.

Impacts to human health from APHIS-WS and WS-Utah's PDM are very low.

4.6.6.6 What are the Comparative Impacts of the Alternatives from Lead Used in Ammunition?

Alternative 1. Proposed Action/No Action Alternative: Continue WS-Utah PDM Program

Impacts of lead to soils, water, plants, terrestrial and aquatic invertebrates, and reptiles from WS-Utah sources of lead from IPDM activities are negligible.

The primary contribution of lead is related to ingestion of leaded ammunition by individual animals and humans from eating meat (or gut piles and meat for scavenging animals) from an animal shot with lead ammunition, as lead bullets fragment into small pieces and spread, making them difficult to contain, find, and avoid in tissue. This is the primary reason for federal and state agencies having policies and regulations, and individual hunters choosing to use non-leaded ammunition, especially in areas with known or expected T&E carnivorous bird species, such as the California condor. Heavy lead loads in raptors have been found to contribute to behavioral changes and even death, with the status of California condors possibly dependent on decreased access to lead in carcasses and gut piles. Impacts on humans, especially during childhood can cause long-term effects on the central nervous system, with behavioral, cognitive, and physiological adverse impacts throughout life. APHIS-WS and WS-Utah use non-leaded ammunition when in accordance with federal and state law and when available, cost-effective, and effective for PDM purposes.

WS-Utah field personnel either retrieve carcasses and discard at approved disposal sites or leave carcasses in the field out of sight of humans and predators and scavengers, when possible. Recreational hunters almost always leave gut piles in the field. Impacts on individual birds and mammals depend on the baseline lead load of an animal, and the volume of lead ingested by each animal from carcasses or gut piles left by WS-Utah and hunters in the field. The cumulative load would determine if an individual animal would exhibit behavioral, physiological, or neurological symptoms of lead poisoning. The level of lead available in the environment contributed by WS-Utah through carcass disposal in the field is extremely low in comparison to that deposited from industrial sources and hunters.

Risks to the health and safety of the public, including recreationists, hunters and domestic animals, are very low on private lands and highly unlikely on public lands due to the low potential to encounter carcasses. WS-Utah employees are professionals who routinely follow WS Directives and standard safety practices, especially the use of PPE and safety requirements, which substantially reduce the risk of major or even minor injury during trapping and snaring activities, based on historical records. Therefore, the risk to field employees is considered very low. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities.

As humans are very unlikely to eat carcasses discarded in the field by WS-Utah, the risk of ingesting lead from WS-Utah activities is negligible. Lead from ammunition would be more likely to be ingested by humans from meat obtained by recreational hunting.

Overall, other than impacts on individual animals, the impact on the environment and risks to humans, and domestic animals from lead associated with WS-Utah PDM activities are very low.

Alternative 2. WS-Utah Provides Lethal Strategies for Corrective PDM Only

Under this alternative, WS-Utah would provide non-lethal and lethal corrective assistance. With this alternative, WS-Utah would use the APHIS-WS Decision Model for providing advice and technical assistance, as well as training on identification of species, and possibly individual animals, causing damage.

Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities. However, depending on the skillset of other entities, effects of lead could be greater than, less than, or similar to those under Alternative 1. It is possible that people, domestic animals, and the environment may have fewer exposures to lead with lethal corrective PDM only from WS-Utah because there may be fewer entities readily available to help address conflicts, and because individuals experiencing damage may not take action themselves. Conversely, people, domestic animals, and the environment could be exposed to lead from an increase in PDM methods and activities by other entities, as a result of greater use of lead shot, more shots per animal taken, and improper carcass disposal. While WS-Utah would still be available for lethal corrective assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual's lack of experience and proficiency.

Therefore, WS-Utah's actions under Alternative 2 would be similar to Alternative 1 for technical assistance and nonlethal IPDM. Overall effects on humans, domestic animals, and the environment will be less when WS-Utah only conducts corrective lethal activities. However, in the absence of WS-Utah's lethal IPDM activities, other entities may expose humans, domestic animals and the environment to more lead.

Alternative 3: WS-Utah Provides Non-lethal Damage Management Only

Under Alternative 3, WS-Utah would provide nonlethal damage management only. Non-lethal methods would not likely cause impacts to humans, domestic animals, or the environment. The APHIS-WS Decision Model may not be fully effective because lethal actions could not be used by WS-Utah during the time that non-lethal methods are attempted to address the immediate problems. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities.

During (or instead of) WS-Utah's non-lethal assistance, landowners could still choose to address the problem by implementing lethal methods before applying all reasonable non-lethal methods. The landowner could use trained and experienced WCOs or may implement lethal methods themselves. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-Utah.

However, similar to Alternative 2, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available. Assuming that commercial WCOs are experienced and proficient, effects of lead on the environment or their safety are probably low. However, landowners or other private entities could use more lead, taking more shots per animal, and improperly disposing of carcasses.

Therefore, the effects of WS-Utah's actions under Alternative 3 would be less on humans, domestic animals, and the environment by not providing lethal assistance. However, other entities may expose humans and domestic animals and the environment to more lead, similar to Alternative 2.

Alternative 4: WS-Utah Provides Technical Assistance Only

Under Alternative 4, WS-Utah would provide technical assistance only. WS-Utah could not use lethal methods as part of IPDM to respond to other types of requests (e.g., agriculture, property, and game species). Because operational lethal actions would not be available to manage damage to other resources, there would be no effects of lead to the environment from WS-Utah. However, other commercial, governmental, and private entities and landowners would continue to conduct or increase their PDM activities.

Since WS-Utah would not be able to respond with lethal methods to damage or threats to any other resources or situations, the impacts would likely be similar to Alternative 2 and 3. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-Utah.

However, similar to Alternative 3, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available. Assuming that commercial WCOs are experienced and proficient, effect of lead on the environment or their safety are probably low. However, landowners or other private entities could use more lead, taking more shots per animal, and improperly dispose of carcasses.

Therefore, WS-Utah's actions under Alternative 4 would be similar to Alternative 3 for technical assistance. Overall effects on humans, domestic animals, and the environment would be less since WS-Utah would not be conducting lethal shooting activities with lead ammunition. However, in the absence of WS-Utah's lethal IPDM activities, other entities may expose humans, domestic animals, and the environment to more lead, similar to Alternative 3.

4.6.7 What are the Potential Impacts and Risks from the Use of Chemical Methods?

In accordance with WS Directives 2.401 and 2.401, all hazardous materials and pesticides are applied, certified, stored, transported, shipped, disposed of and use supervised in compliance with applicable Federal, State, Tribal, and local laws and regulations. All restricted use pesticides used or recommended by WS-Utah personnel must be registered with EPA and UDAF. All hazardous materials and pesticides purchased, stored, and used must be carefully tracked and accounted for. Subject matter included in the annual physical inventories includes security, storage, warning signs, inventory, receipt and transfer of documentation, handling, disposal, immobilization and euthanizing drugs, and pyrotechnics. All storage, transportation, inspections, training, and emergency procedures are conducted according to Appendix 1 of WS Directive 2.401.

4.6.7.1 What are the Potential Impacts and Risks from the Use of Sodium Cyanide in M-44s?

The M-44 is a spring-activated device that delivers a single dose of sodium cyanide powder directly into the mouth, eyes, or nose of targeted animals. It uses a cyanide capsule registered as a restricted use pesticide with the EPA, with APHIS-WS as the principle registration holder. It can only be used by trained, certified applicators who are directly employed by APHIS-WS. The departments of agriculture in the states of South Dakota, Montana, Wyoming, New Mexico, and Texas, also have active long-term FIFRA registrations allowing applicators other than APHIS-WS to apply them (https://iaspub.epa.gov/apex/pesticides/f?p=200:6:::NO::P6_XCHEMICAL_ID:3847).

Each APHIS-WS certified applicator must be trained in the safe handling of the capsule and device, the proper use of the antidote kit, proper placement of the device for safety and selectivity, and necessary recordkeeping. The devices and capsules cannot be sold, transferred, or entrusted to the care of any person not directly supervised by APHIS-WS or an agency working directly under an APHIS-WS or WS-Utah cooperative agreement. However, cooperators under APHIS-WS supervision can monitor deployed M-44s.

The FIFRA label issued by EPA to APHIS-WS for the M-44 device has 26 use restrictions, and state regulatory agencies can require additional restrictions within the state.

M-44 devices are only used in rural public and private settings by WS-Utah for coyote and, rarely for red and gray fox, per EPA and APHIS-WS restrictions (WS Directive 2.415).

From FY 2015, WS-Utah used .15 lbs of sodium cyanide (MIS 2016). In FY 2015, 68 depredating coyotes and 6 red fox were taken statewide by WS-Utah with M-44s. The use of M-44s in Utah has been decreasing over the last five years. Nationally, canids triggered 98.7% of all M-44s fired with known take. Of the annual average of 30 feral or free-ranging dogs taken as non-target species nationally, seven dogs were not under the control of their owners, while the rest were feral dogs or dogs without a collar. Other non-target carnivores accounted for 1.2% of the total take, and non-carnivore non-target take accounted for 0.1% of the total take. WS-Utah, did not take any Federally-listed threatened or endangered species from 2011 through 2015 by any means.

The risks to human health and safety and the environmental impacts and fate of sodum cyanide in M-44 devices are found in the following sections. In addition, further detail on risks associated with the use of sodium cyanide in M-44 devices are available in the *WS Use of Sodium Cyanide in Wildlife Damage Management Risk Assessment* (WS 2017i).

What are the Potential Impacts on the Terrestrial and Aquatic Environment and Fish from the Use of Sodium Cyanide in M-44s

Sodium cyanide is soluble in water, and is slowly decomposed by water and rapidly decomposed by acids to give off hydrogen cyanide, a flammable poisonous gas. It volatizes from water surfaces and does not persist in surface waters. Hydrogen cyanide does not bioaccumulate in aquatic or terrestrial or terrestrial organisms (Dzombak et al. 2006). The EPA registration and WS Directive 2.415 for M-44 devices prohibit its use within 200 feet of a water source.

The toxicity of sodium cyanide and hydrogen cyanide in aquatic environments depends on the size of the water body (degree of dilution), physical and chemical characteristics (temperature, pH, and oxygen concentrations), closeness of the organism to the source of contamination, and the rate of degradation of the cyanide (Towill et al. 1978). Although studies have demonstrated deleterious effects from cyanide in fish (Ketcheson and Fingas 2000), the low risk of a cyanide capsule actually spilling, the small quantity of powdered cyanide in each capsule, and the distance from any water body (at least 200 feet) creates a negligible risk of cyanide poisoning occurring in fish and the aquatic phases of amphibians.

Sodium cyanide from M-44 capsules is released only when an animal of the proper size and strength is able to trigger the device, and the cyanide is released into the animal, not into the environment. An accidental release to the environment of small amounts is restricted to the spill sites and rapidly degrades in soils and volatizes in water. Therefore, the risk of the small amount of sodium cyanide within a single capsule and the restriction of its use within 200 feet of a water source creates a negligible risk to terrestrial and aquatic organisms and water quality.

What are the Potential Impacts on Non-target Mammals and Birds from Sodium Cyanide in M-44s

Despite the high toxicity of sodium cyanide to mammals and birds (Weimeyer et al. 1986, Ketcheson and Fingas 2000, ATSDR 2006, EPA 2010), and because M-44s are highly selective for wild canids (for example, Shivik et al. 2014; Section 3.9.5.3.1), the risk of non-target wild mammals and birds triggering an M-44 and getting a lethal dose is very low. The unintentional take of animals other than target canids by APHIS-WS nationwide averaged 2.5% a year (MIS data 2011 through 2015).

What are the Potential Risks to Human Health and Safety of the Public, Recreationists, Hunters, and Pets from Sodium Cyanide in M-44s

Sodium cyanide forms a highly toxic (to humans) gas when exposed to moisture. Symptoms of acute cyanide exposure includes high blood pressure, rapid heart rate, followed by low blood pressure and slow heart rate, a blue tint to the skin and cherry-red or bloody mucous membranes, pulmonary edema and lung hemorrhage, headaches, dizziness, agitation, dilated and unreactive pupils, convulsions, paralysis and coma, often with increased salivation, nausea, and vomiting (https://m.cameochemicals.noaa.gov/chemical/4477, EPA 2010). Sodium cyanide is corrosive to the skin and eyes, but exposure of intact skin is less hazardous than exposure through other routes with permeable membranes.

Symptoms of chronic sublethal exposure may include lesions of the optic nerve, depressed thyroid function, and muscle weakness and lack of muscle control. A lethal dose for humans ranges from approximately 0.15 to 0.2 g (0.0068 ounces) for a 150-pound person (EPA 2010).

Per the label, applicators must wear gloves and eye protection to avoid exposures to the eyes and skin.

WS-Utah use of sodium cyanide capsules poses negligible risk to the public who obey the law because the product labels restrict use to only certified applicators, who are required to follow the label restrictions; the products are not commercially available to the public.

What are the Potential Risks to WS-Utah Employees from Sodium Cyanide in M-44s

The risk to applicators is slightly greater than the risk to the public because applicators handle the devices and capsules as part of their fieldwork. Applicators may be exposed either dermally or through inhalation. Risk from dermal exposure is low, unless the skin is moist or broken due to a wound or scratch. An LD_{50} for hydrogen cyanide adsorption through the skin is 100 mg/kg (100 ppm; Towell et al. 1978). Moving away from the point source is unlikely to reduce the risk to applicators because hydrogen cyanide is lethal to humans at low concentrations and reacts rapidly in the human body. The symptoms of cyanide exposure may also interfere with the person's mobility.

Over the 32 years recorded, the majority of exposures were from 24 accidental discharges that occurred while employees were setting, inspecting, or pulling M-44s; one discharge was an improper action of an employee involving transporting a set M-44 from one location to another.

The risk to WS-Utah certified applicators is low as applicators receive proper training in the product's use, follow label instructions, and wear protective clothing, including water proof gloves and a full face shield. In the highly unlikely event that a WS-Utah field employee is exposed to cyanide, they are directed to call the local poison control center immediately. Use of M-44 devices by WS-Utah employees is decreasing.

4.6.7.2 What are the Impacts and Risks of Sodium Nitrate as Used in Gas Cartridges?

Gas cartridges are pyrotechnic fumigants used to target animals that live in burrows or dens, such as coyotes, skunks, and badgers. The cartridges contain the active ingredients sodium nitrate ($NaNO_3$) and charcoal, combined with two inert ingredients, Fuller's earth and borax. The sodium nitrate supports the combustion of the charcoal, which emits carbon monoxide (CO) during the burning, as well as lesser chemicals, such as sodium carbonate (Na_2CO_3 and nitrogen gas (N_2). The Fuller's earth and borax control the rate of the burn. After clearly identifying the species currently using the den as required by the label and before treating an active burrow or den of the target species, the certified applicator blocks all identifiable den or burrow openings so that the CO is fully enclosed in the den. The cartridges are cardboard tubes with cardboard caps that are punctured just prior to use, the fuse inserted into the end of the tube containing the formulation, the fuse is lit, inserted deep into the burrow, and the opening to the burrow blocked to provide for sufficiently high levels of CO to be rapidly lethal. One or two cartridges may be used, depending on the size of the animal and burrow, including burrows suspected to have multiple runways.

The CO created by the combustion of sodium nitrate and charcoal is a clear odorless, colorless gas and poisonous to all animals that use hemoglobin to transport oxygen from the lungs to the cells of the body because the carbon monoxide attaches to the hemoglobin, replacing oxygen and causing the animal to quickly suffocate. The American Veterinary Medical Association (AVMA 2013) recommends the use of CO for euthanasia because it quickly induces unconsciousness without pain, and death occurs rapidly.

Sodium nitrate dissolves in moist air and is very soluble in water. Charcoal is created from charring peat or wood into a solid or powder and is non-hazardous, biodegrading in the environment. It is not soluble in water, and is stable unless exposed to an ignition source, whereupon it creates CO. CO is flammable and highly toxic, and is also created by burning fossil fuels for energy and vehicles (EPA 2010). Sodium carbonate is also created by the burning process, is naturally occurring in soil and water, and is used to make glass and soaps. Nitrogen gas (N_2) is a byproduct of the combustion, occurs naturally in the environment, and comprises 78% of the earth's atmosphere. Fuller's earth is a natural clay material and borax is a salt that is a common ingredient in detergents and cosmetics.

The EPA registration is a general use or not restricted use pesticide for use by any member of the public over the age of 16, similar to any other pesticide available for retail sale.

The method is often recommended in the literature for taking coyote pups to reduce the potential that the alpha pair will cause livestock depredations to provision the pups. It is the only way to be certain that the alpha pair is being targeted, and studies have suggested that the alpha pair may start or increase livestock depredation during the pupping season in the spring that overlaps with the lambing or calving season for providing ready and sufficient food for growing pups. Removing the pups removes the need to provision the pups, typically resulting in reducing livestock depredation.

WS-Utah uses gas cartridges sparingly during PDM activities, mostly limited to coyote, with limited use on red fox dens.

Further details on the risks to human health and safety and the environmental impacts and fate of carbon monoxide from gas cartridges and forced gas fumigation systems are found in the following sections. In addition, further detail on risks associated with the use of carbon monoxide in gas cartridges and forced gas fumigation systems are available in the *WS Use of Carbon Monoxide from Gas Cartridges and Forced Gas Fumigation Systems in Wildlife Damage Management Risk Assessment* (WS 2017j).

The cardboard cartridge burns in the burrow or degrades when exposed to soil moisture. Sodium nitrate that is not burned is not volatile and remains as a particulate in the soil until it degrades through microbial activity, converting it to N_2, which enters the nitrogen cycle and does not produce any hazards. Burning sodium nitrate creates simple organic and inorganic compounds, mostly in the form of gases, which diffuse through the soil. Sodium carbonate dissociates in water to sodium, a salt, and carbonate ions, neither of which adsorb on soil particles or bio-accumulate in living tissues. The CO created by burning charcoal in the burrow is inhaled by the animals, degraded by soil microorganisms, is converted to carbon dioxide, or fixed by bacteria (ATSDR 2012).

Because these chemicals are widespread and naturally occurring in the environment, are localized inside the burrows, and impacts are negligible, EPA waived the requirement for conducting environmental fate studies (EPA 2008).

Predator burrows are easy to identify based on tracks, observed activity, and presence of scat. The risk of non-target birds or mammals co-occurring in an active predator burrow is very low, as they could become readily accessible prey. It is highly unlikely that another bird or mammal would co-occur with a skunk in a burrow.

The potential risk to the environment from the component chemicals and resulting chemicals after pyrolysis is minimal. The potential to take non-target species when using gas cartridges for coyote or fox is very low.

What are the Potential Risks to the Public, Recreationists, Hunters, and Pets from Sodium Nitrate as Used in Gas Cartridges?

Sodium nitrate is an eye irritant and can irritate the skin. Acute oral toxicity is very low, with the LD_{50} for domestic rabbits at 2,680 mg/kg respectively (OECD 2007). Sodium carbonate has low toxicity to humans and low or no skin irritation potential (OECD 2002). CO rapidly causes asphyxiation and death.

All components and combustion byproducts are enclosed in the cardboard gas cartridges that are further enclosed in sealed burrows, and the applicators conduct burrow treatments when no people are present. Therefore, the risk for health and safety impacts and impacts on a recreational or hunting experience are minimal.

What are the Potential Risks to APHIS-WS and WS-Utah Field Employees from Sodium Nitrate as Used in Gas Cartridges?

Exposure risk for WS-Utah gas cartridge applicators has the potential to be higher than for the public, recreationists, hunters, and pets because the employees actually handle the gas cartridge. Because gas cartridges are ignited using a timing fuse, the applicator has sufficient time to move away before ignition occurs and CO is created. All components and combustion by-products are enclosed in cardboard gas cartridges that are enclosed in sealed burrows. No APHIS-WS or WS-Utah employee has been injured by using gas cartridges. Therefore, the risk of any adverse impacts to WS-Utah employees is minimal.

4.6.7.3 What are the Impacts of Sodium Fluoroacetate as Used in Livestock Protection Collars?

Livestock Protection Collar (LPC): The LPC containing the chemical sodium fluoroacetate (Compound 1080) is registered with the EPA (EPA Reg. No. 56228-22) for APHIS-WS use nationwide. Before use in individual states, the registrant must receive approval from the State agency that oversees pesticide usage. The LPC is incorporated into the current IWDM program. WS-Utah use of the LPC follow WS Directive 2.420, EPA registration, and UDAF requirements, and is restricted to specially trained and certified WS-Utah employees. In FY10 through FY14, a total 4 LPCs were punctured to resolve depredation incidents (MIS 2010, 2011, 2012, 2013 and 2014). In FY15, no LPCs were punctured (MIS 2016).

Sodium fluoroacetate has been used since World War II, and has been the subject of wide research in the United States and elsewhere and has been widely used for pest management programs in many countries. Fluoroacetic acid and related chemicals occur naturally in plants in many parts of the world and are not readily absorbed through intact skin (Atzert 1971). Sodium fluoroacetate is discriminatingly toxic to predators, being many times more lethal to them than to most nontarget species (Atzert 1971, Connolly and Burns 1990). Sodium fluoroacetate is a white powder soluble in water and is very stable in solution; it would only be used in the LPC. Sodium fluoroacetate kills by disrupting the Kreb's Cycle, which is the energy producing process for cells. Many EPA imposed restrictions apply to the use LPCs (EPA Reg. No. 56228-22).

The LPC is constructed to fit two different size lambs. An individual collar contains 1.1 oz. (30.4 grams) of a 1% solution of sodium fluoroacetate and 99% inert ingredients. The LPC is worn around the neck of lambs and kills only the animal attacking collared lambs (Connolly et al. 1978, Johnson 1984, Burns et al. 1988). When LPCs are used, lambs are made susceptible to attack to prompt target predators to attack collared lambs (Blakesley and McGrew 1984, Scrivner and Wade 1986, Connolly and Burns 1990). LPCs consist of two bladders that are punctured when a collared lamb is attacked and bitten on the throat by a predator. Upon puncturing the collar, the offending animal ingests some of the solution and dies. In this usage, sodium fluoroacetate has virtually no risk of secondary poisoning.

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 1080 collars (EPA 2009). Based on the review, the EPA determined that use of the products in accordance with label requirements and revised WS pesticide accounting and storage practices does not pose unreasonable risks to the environment. There have been not instances of human or pet injuries associated with the use of this device in Utah.

4.6.7.4 What are the Potential Impacts and Risks from Use of Immobilization and Euthanasia (Humane Killing) Drugs?

Immobilization and euthanasia (I&E) chemicals are described in Appendix E, and evaluated for humaneness in Section 4.6.7.3).

WS Directives 2.505 and 2.430 provide guidance for euthanizing and immobilizing animals. All WS-Utah personnel using I&E drugs must undergo full training and certification as described in Attachment 1 of WS Directive 2.430. Only I&E drugs approved by the APHIS-WS I&E committee may be used by APHIS-WS personnel, unless under emergency situations. Attachment 2 of WS Directive 2.430 lists the approved I&E drugs. Under an emergency situation, a drug not listed in Attachment 2 may be used, but only when approved on a one-time or limited basis by an attending/consulting veterinarian and the State Director or designee, provided that such use is in compliance with all applicable laws.

Further detail on risks associated with the use of immobilization and euthanasia (humane killing) drugs are available in *the WS Use of Immobilization and Euthanasia Drugs in Wildlife Damage Management Risk Assessment* (WS 2017).

Although unlikely, in the event that WS-Utah is requested by UDWR to immobilize a bear during a period of time where the drug withdrawal period could overlap with the start of a regulated harvest season, WS-Utah would either euthanize the bear or mark the animal with ear tags labeled with a "do not eat" warning prior to release.

WS Directive 2.515 directs that animals euthanized with drugs such as sodium pentobarbital (Beuthasia D) that may pose secondary hazards to scavengers must be disposed of according to Federal, State, county, and local regulations, drug label instructions, or, lacking such guidelines, by incineration or at a landfill approved for such disposal.

Inventories of all I&E drugs are conducted at least once per year for correct storage, inventorying, and documentation to ensure that all drugs purchased are accounted for (WS Directive 2.465).

WS-Utah uses very few I&E drugs. Euthanasia is primarily performed by shooting at close range. Immobilization drugs are applied only when an animal must be transferred/transported safely and humanely or when captured in a public area with high visibility and at the direction and approval of UDWR (because all wildlife relocated in the state must be approved by UDWR prior to relocation). Immobilization would occur primarily for bear and cougar under limited circumstances; all other animals are euthanized per state law and regulation and state and APHIS-WS policies. The immobilization drug would be administered directly by either hand syringe, pole syringe, or dart gun at close range (Appendix E).

What are the Overall Environmental Impacts and Health and Safety Risks Associated with Use of I&E Drugs

As only small amounts of I&E drugs are used by WS-Utah in a year, a highly trained field employee performs any use of drugs. Drugs are administered at close range or by hand so there is negligible risk to release into the environment. Also, as all drugged animals are either marked or disposed of in compliance with law and APHIS-WS policy, the risk of adverse impacts on the environment, animals, the public, recreationists, hunters, and WS-Utah field employees is negligible. No other entities would be expected to use I&E drugs.

4.6.7.5 What are the Comparative Impacts of the Alternatives from the Use of Chemical Methods?

Alternative 1. Proposed Action/ No Action Alternative: Continue WS-Utah PDM Program

All certified APHIS-WS employees must demonstrate their proficiency in the safe and effective use of M-44s consistent with the label restrictions and their field supervisor conducts at least one field inspection a year for verification. The risk to WS-Utah certified applicators is low when using M-44s, as all applicators receive proper training in the product's use, follow label instructions, and wear PPE (including water proof gloves and a full face shield). Additionally, in the highly unlikely event that a WS-Utah field employee is exposed to sodium cyanide, they are instructed to call the local poison control center immediately for help. All sodium cyanide capsules not deployed in a device are always locked and secured at all times, restricting the potential for a person to contact an isolated sodium cyanide capsule.

The use of M-44s on public lands with the potential for public recreation use is highly restricted per the EPA registration and WS Directive (Section 2.4 A6), and any use on federal land must be documented with the federal agency. Label restrictions also limit the potential for humans or domestic animals to encounter a device set on public land. Use of M-44s on private land is by the permission of the landowner, who would warn others on their property of the presence and location of the devices. Bilingual signs surrounding the device and entry signs are used to alert the public to the presence of M-44 devices and to not tamper with them. Individuals in remote areas away from paths or trails may encounter an M-44, but with only 10 to 12 placed in any one square mile per EPA label restrictions, and restrictions on placement of M-44s on areas open for non-dispersed public recreation, the risk of such an encounter is low.

A person finding a dead coyote is highly unlikely to either eat it or let their pet dog eat it. Any cyanide in the carcass would be distributed throughout tissues, resulting in low potential for any lethal dose to be obtained from scavenging on a carcass. A sub-lethal dose obtained by a dog would break down into a nontoxic chemical and be excreted in the urine within twelve hours.

The EPA label restricts the potential for use of M-44s by other entities. WS-Utah use of sodium cyanide capsules poses negligible risk to the public because the product labels restrict use to only certified applicators, who are required to follow the label restrictions; the products are not commercially available to the public. WS-Utah always follows the use restrictions on the product label.

The risk of the small amount of sodium cyanide within a single capsule and the restriction of its use within 200 feet of a water source creates a negligible risk to terrestrial and aquatic organisms and water quality. The selectivity of M-44s to canids and low use by WS-Utah indicate that the risk of non-target wild mammals and birds triggering an M-44 and getting a lethal dose is low. Therefore, the impact on the environment is negligible. The risk to the public, domestic animals, and WS-Utah employees is very low when used according to the restrictions in the EPA label and APHIS-WS directives.

The potential for impacts on the environment and risks to people and domestic animals from sodium nitrate (gas cartridges) is negligible because the chemical has low toxicity and is used entirely within an enclosed burrow. No APHIS-WS or WS-Utah employee has been injured by using gas cartridges, and the use of these cartridges by WS-Utah field personnel is very low.

As only small amounts of I&E drugs are used by WS-Utah in a year, only highly trained field employees administer I&E drugs. Drugs are administered at close range or by hand, resulting in negligible effects to the environment, people, or domestic animals. Also, as all drugged animals are either marked or disposed of in compliance with law and APHIS-WS policy, the risk of adverse impacts on the environment, animals, the public, recreationists, hunters, and WS-Utah field employees is negligible.

Therefore, based on detailed *WS Risk Assessments*, risks to people, domestic animals and the environment from WS-Utah's use of chemical methods would remain low under the continuation of Alternative 1.

Alternative 2. WS-Utah Provides Operational Lethal Strategies for Corrective PDM Only

Under this alternative, WS-Utah would provide lethal corrective assistance, and non-lethal technical assistance only. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities. With this alternative, WS-Utah would use the APHIS-WS Decision Model for providing advice and technical assistance, as well as training on identification of species, and possibly individual animals, causing damage.

Relatively few WCOs are available for large predator damage management, but landowners can request someone to work as their agent. M-44s are not registered for use by non-WS entities in Utah. Private individuals are not likely to have the training and authorization to use immobilization and euthanasia drugs (chemicals) and it is unlikely that WCOs will have access to them. UDWR, USFWS, or other agencies are likely the only ones to use I&E drugs, and will have the necessary training, expertise, and protocols (similar to WS-Utah) to minimize effects to the environment, humans, and domestic livestock. Sodium nitrate in large gas cartridges isn't a restricted-use pesticide and could be used by private individuals and or public agencies; however, it is not currently registered in Utah for use other than for WS-Utah. If it is registered, applicators would be required to follow the label restrictions from the EPA, and follow ESA guidelines for minimizing risks to the environment, people, and domestic animals.

Few individuals would have the training and authorization to utilize chemicals that WS-Utah could use under Alternative 1. As discussed in Alternative 1, effects to the environment, people, and domestic animals from sodium nitrate is negligible, and under Alternative 2 is likely to be used less frequently, if at all, by other entities. Effects from immobilization drugs used for non-lethal PDM by WS-Utah would be the same as under Alternative 1, and likely the same effects when other trained and authorized individuals used both immobilization and euthanasia dugs. M-44's would not be used under Alternative 2 and therefore potential effects would be less than Alternative 1.

Therefore, the risks to the environment, people, and domestic animals under Alternative 2 would be less than Alternative 1.

Alternative 3. WS-Utah Provides Non-lethal Damage Management Only

Under Alternative 3, WS-Utah would provide technical and operational assistance for non-lethal activities. The APHIS-WS Decision Model may not be fully effective because lethal actions could not be used by WS-Utah. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities.

During (or instead of) WS-Utah's non-lethal assistance, landowners could still choose to address the problem by implementing lethal methods before applying all reasonable non-lethal methods. The landowner could use trained and experienced WCOs or may implement lethal methods themselves. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-Utah.

Alternative 4. WS-Utah Provides Technical Assistance Only

Under Alternative 4, WS-Utah would provide full PDM technical assistance (Appendix A). WS-Utah could not use lethal methods as part of IPDM to respond to requests. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activity.

During (or instead of) WS-Utah's technical assistance, landowners could still choose to address the problem by implementing PDM methods themselves. The landowner could use trained and experienced WCOs or may implement lethal methods themselves. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-Utah. However, similar to Alternative 3, chemicals used by other entities would likely be less than those used by WS-Utah under Alternative 1.

Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-Utah.

Under alternative 4, overall effects on humans, domestic animals, and the environment would be less since WS-Utah would not be conducting lethal chemical activities. However, in the absence of WS-Utah's lethal chemical activities, other entities may present more risks to humans and domestic animals, but impacts on the environment are expected to be similar to Alternative 1.

4.7 Direct, Indirect, and Cumulative Effects of Proposed Activities on Soils, Water Quality, Watersheds, Native Vegetation, and Recreation (i.e., road building, oil and gas development, timber harvest, etc.)

Potential adverse effects on soils, water, watersheds, and native vegetation would be very minimal to nonexistent. WS-Utah does not conduct any construction activities on public lands nor harvest timber or other habitat, or develop oil and gas resources. The WS-Utah program coordinates its PDM with the Forest Service, BLM, USFWS, and the UDWR to help ensure there are no significant direct, indirect or cumulative affects to any resources managed by these agencies.

WS-Utah PDM may involve activities such as driving a pickup truck on a road, riding a horse through forests or rangelands, or concealing a leg-hold trap with dirt, but these activities would not reasonably be expected to have any significant adverse effects on soils, water, watersheds, or native vegetation. If PDM is conducted in situations where local travel may be difficult due to muddy road conditions, WS-Utah field employees exercise conservative judgment to mitigate any potential damage to roads or roadside vegetation. In some cases this may mean delaying travel through certain areas until road conditions improve, or using alternate means of transportation such as horses. WS-Utah employees are also cognizant of the threat of noxious weeds to rangelands and watersheds, and exercise routine preventive measures to reduce the likelihood of spreading noxious weeds (*e.g.*, using weed-free feeds for horses when appropriate, and routinely checking and clearing vehicle bumpers and undercarriage for any weeds or other vegetation). Potential adverse effects of PDM on wildlife and recreation are analyzed in detail in Chapter 4 to fulfill the WS-Utah NEPA requirements for taking a hard look at potential impacts.

4.8 SUMMARY OF WS-UTAH IMPACTS

No significant cumulative environmental impacts are expected from any of the alternatives analyzed in this EA. Under the Current/Proposed Action, the lethal removal of predators by WS-Utah would not have a significant impact on overall predator populations in Utah. No risk to public safety is expected when WS-Utah PDM services are provided and accepted by requesting individuals under Alternative 1, since only trained and experienced wildlife biologists/specialists would conduct and recommend PDM activities. There is a slight increased risk to public safety when persons who reject WS-Utah assistance and recommendations in Alternative 1 and conduct their own PDM. In all four Alternatives, however, potential impacts would not be to the point that the impacts would be expected to be found as significant.

Table 4-15 is a comparison of the alternatives and environmental consequences (impacts). The level of impacts is based on the above analysis and rated as: Neutral, Neu/Low, Low, Low/Moderate, Moderate, Moderate/High, and High. The impacts are also rated in a positive (+) or negative (-) manner, in that, the impacts are based on individual or society's perception of how the impact could affect the environment.

Issues/Impacts	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Target Species Populations	Low (-)	Low (-)	Low (-)	Low/Mod (-)
T/E and Sensitive Species	Low (-)	Low (-)	Low (-)	Low/Mod (-)
Special Land Management Areas	Low	Low	Low	Low
Methods*	Moderate	Low	Low	Low
Cost-Benefit	Mod (+)	Low (+)	Low (-)	Low (-)

Under the Proposed Action, the lethal removal of predators to protect livestock, crops, property, natural resources, and human health and safety would not have a significant impact on overall predator populations in Utah. No risk to public safety is expected when WS-Utah services are provided and followed by requesting individuals under Alternatives 1, 2, or 3, since only trained and experienced WS-Utah professionals would conduct and recommend PDM activities. There could be increased risk to public safety when a person rejects WS-Utah assistance and recommendations under Alternatives 1, 2, 3 or 4. Although some persons will likely be opposed to WS-Utah proposed PDM program, the analysis indicates that WS-Utah IWDM program will not result in any significant, cumulative, or adverse impacts on the quality of the human environment.

CHAPTER 5: RESPONSES TO PUBLIC COMMENTS

WS-Utah received 121 comment letters that contained a combined total of approximately 265 individual comments. Many of these comments were identical or substantially similar so "like" comments were grouped together. Below, we have summarized the comments into 49 individual comments and provided responses to them. 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. WS-Utah has provided responses to the substantive comments in the section 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 numerous comments on the draft EA which are categorically outside the scope of the EA.**
   Comments on topics outside the scope of the EA include; comments opposing or supporting certain actions or alternatives without providing any further context, decisions regarding state laws, hunting regulations in Utah, trap and neuter regulations for feral cats in Utah, NEPA documents from other WS states, lethal wolf management, providing habitat for wildlife, ranching/grazing laws, and other land management decisions that WS-Utah has no regulatory authority over.

2. **Commenters submitted numerous research articles without any context or explanation of why WS-Utah should consider them.**
   WS-Utah reviewed and considered all of 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-Utah, if they did not add anything to the analyses in the EA, then WS-Utah did not site 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.

3. **WS-Utah received numerous comments regarding our involvement with feral cat damage management in the state of Utah.**
   Many of the commenters oppose WS involvement in feral cat damage management for various reasons, most of which are not supported by professional wildlife biologists. Due to the very limited involvement and minimal amount of anticipated take (<30/yr) of feral cats by WS-Utah, WS-Utah determined that the proposed action would have no significant impact to feral cat populations in Utah. As stated in the EA; feral cats are not a part of native ecosystems in Utah and therefore any feral cats removed by WS-Utah would likely have a positive benefit to the environment, since feral cats are an ecological pest. WS is not responsible for any decisions regarding TNR programs, animal shelters, or laws related to feral cat management in Utah, or in any other state. Feral cats are not pets, they are destructive to native wildlife, and pose a significant risk to human and pet health and safety. Section 4.3.1.10 of the EA Further analysis WS-Utah's PDM programs

involvement in feral cat damage management. Private individuals or businesses that request WS-Utah to assist with feral cat damage management pay for the full cost WS-Utah's services, therefore tax dollars are not used to manage feral cats as stated by the numerous commenters. The humaneness and ethics of WS-Utah's PDM methods are adequately analyzed in section 4.5 of the EA.

4. **WS-Utah received several comments opposing the use of M-44s for PDM due to the potential risk to human and pet safety and nontarget or sensitive species.**
   Although a rare occurrence, incidents with M-44s generate intense media and public scrutiny. The agency has responded to a recent incident in Idaho, in which a dog that was being walked by a young boy was killed by an M-44 that was set by a WS employee. This incident triggered an incident investigations and an internal review and revision of implementation guidelines to provide M-44 applicators with specific steps they can take to minimize the risk of a similar occurrence happening. WS established interim guidance requiring M-44 devices to be placed at least a ½ mile from any occupied residences. The interim guidance remained in place while WS' conducted its investigation and review and additional analysis of M-44 risk to nontarget animals, including pets.

   The 2017 Risk Analysis helped determine the minimum safe distance M-44 devices could be set around occupied residences. Discussion of the risk analysis' findings by the APHIS Administrator and WS Management Team resulted in the continuation of the requirement that M-44 devices be placed at least ½ mile from occupied residences and that residences near the ½-mile perimeter be notified of the presence of the devices. The ½ mile perimeter is determined using information maps, GPS, GIS and other available technologies to assure devices are placed appropriately on public and private lands. Applicators may request and a waiver to allow for M-44 devices to be placed between ¼ and ½ mile of an occupied residence, provided they've determined that other alternatives are ineffective or impractical and documented notification of potentially affected residents. The waiver must be specific to the property under agreement and signed by the regional office. Under no circumstances are M-44 devices to be placed within a ¼ mile of an occupied residence.

   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 2/27/2018) 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. **The EA fails to analyze the status of the environment in the absence of, or even with lower levels of, PDM, speculating that WS-Utah's involvement in PDM does not affect the status quo.**
   WS-Utah disagrees with this claim. Alternative 2, 3 and 4 analyze lower levels of PDM compared to Alternative 1, which is the baseline alternative. Section 3.6.2 of the EA

adequately explains what would occur if there were no federal PDM conducted by WS-Utah. Under the Utah Agricultural and Wildlife Damage Prevention Act, and under the authority of UDAF and UDWR, the state of Utah would continue the PDM work that WS-Utah currently conducts. Therefore, there would be minimal impact on the status quo.

6. **WS avoids conducting any analysis of the environmental baseline in the absence of PDM.**
   WS-Utah disagrees with this claim. Refer to section 4.1.1 of the EA. The No Action alternative is a procedural NEPA requirement (40 CFR 1502.14(d)), is a viable and reasonable alternative that could be selected, and serves as a baseline for comparison with the other alternatives. The No Action Alternative, as defined here, is consistent with CEQs definition (CEQ 1981). Alternative 1 is the No Action Alternative and is the Preferred Alternative. WS-Utah has been conducting PDM in Utah for decades. The consideration of past actions may be considered in a cumulative impact analysis as the baseline to which the impact associated with the proposed action or alternative is compared and contrasted.

7. **The EA fails to analyze the cumulative impacts of PDM.**
   WS-Utah disagrees with this claim. WS-Utah believes that the EA provides an adequate cumulative impacts analysis for each of the Alternatives in chapter 4 of the EA. WS-Utah has made the determination of finding of no significant impact for the preferred Alternative.

8. **Estimates of livestock losses in the EA are unreliable. The NASS reports are based solely on reports by ranchers, which likely reflect an inherent bias.**
   WS-Utah does not agree that NASS figures reflect an inherent bias. This comment is addressed in Section 4.4.1 of the EA. NASS is the National Agricultural Statistics Survey section of the US Department of Agriculture. It conducts the most comprehensive surveys of the status of agriculture in the US. The results of NASS surveys used in this EA are those that are pertinent to Utah, either nationally, or statewide, and are the most recent**.** WS-Utah uses the best available data and science for the EA.

9. **The agency should not rely upon unverified losses to justify PDM.**
   WS-Utah does not rely solely on unverified losses to justify the need for PDM action. The Need for Action is adequately explained in section 1.3 of the EA.

10. **What are updates regarding the implementation of PDM in Utah compared to the previous Northern and Southern Utah PDM EAs?**
    The new EA covers the actions in the entire state of Utah. As described in Section 1.3 of the EA; WS-Utah has decided that one EA analyzing potential operational impacts for the entire State of Utah provides a more comprehensive and less redundant analysis than

multiple EAs covering smaller regions. This approach also provides a broader scope for the effective analysis of potential cumulative impacts and for using data and reports from state and federal wildlife management agencies, which are typically on a state-wide basis. There are also updates to the WS-Utah operating policies in section 3.5 of the EA.

11. **The EA fails to conduct an economic cost benefit analysis**.
    NEPA does not require agencies to conduct an economic analysis or disclose financial information in EAs. For further explanation on this topic refer to section 1.12.2 of the EA.

12. **The EA fails to fully analyze PDM impacts on ecosystem function.**
    WS-Utah made a finding of no significant impact FONSI for its PDM actions based on conclusory findings that reflect adequate consideration of the context and intensity of potential environmental impacts of each alternative according to NEPA regulation. WS-Utah does not propose to disrupt or have a significant impact on any species populations or keystone species. For further information on this topic refer to Chapter 4 and Appendix G of the EA.

13. **The removal of other Wildlife Damage Management actions conducted by WS-Utah from this EA is improper segmentation.**
    WS-Utah disagrees with this claim. This EA is for PDM actions only. Other wildlife damage management actions conducted by WS-Utah are covered under other NEPA documents.

14. **Is WS-Utah PDM effective? Scientific studies provided by commenters question the efficacy of PDM.**
    Efficacy of PDM is discussed in section 1.11.2 of the EA, including numerous references to substantive literature cited by the commenters.

15. **Commenters claim that WS-Utah must prepare an EIS because their actions are controversial.**
    WS-Utah does not agree with commenters claims that PDM actions are controversial. This issue is discussed in section 1.10.4.1 of the EA. The rationale for preparing an EA instead of an EIS is discussed in section 1.10.3 of the EA.

16. **Commenters claim that WS-Utah must prepare an EIS because WS-Utah failed to take a hard look at the effects of PDM on the environment.**
    WS-Utah disagrees with this claim. WS-Utah 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.

17. **Several commenters claimed that WS-Utah failed to accurately describe the impacts of each alternative and that only an EIS would be sufficient.**

WS-Utah disagrees that the claim that the description of the impacts from each of the alternatives analyzed in the EA is inadequate. WS-Utah has been conducting PDM in Utah for decades without any significant impacts to the human environment resulting from their actions.

18. **Several commenters claim that the lethal methods used for PDM by WS-Utah are unethical and inhumane.**
WS-Utah disagrees with this claim. Section 4.5 of the EA is a full analysis of ethics and humaneness of WS-Utah's PDM actions.

19. **Several comments claim that WS-Utah disregards the effects of pain and suffering to target and nontarget species from PDM in the EA.**
WS-Utah does not disregard pain and suffering in the EA. Refer to section 4.5 of the EA. WS-Utah also follows AVMA guidelines for euthanasia approved best management practices (BMPs) for trapping. Refer to Section 4.5 and 3.5.2.4 for a full analysis on humaneness and ethics of PDM.

20. **A comment was received that requested that WS-Utah should abide by a 24hr trap check policy.**
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-Utah 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 (Sections 2.4of the EA) and Appendix E of the EA.

21. **A commenter claimed that The EA points to the belief that "man has a moral obligation to protect domestic animals" to support lethal predator control.**
The EA does not state that the man has a moral obligation to protect domestic animals to support "lethal predator control". The EA states in that paragraph that for PDM to be successful, livestock producers and resource managers need to incorporate a variety of techniques that integrate social, ethical and economical concerns, as well as the biology of the species in the development of management strategies. Not just lethal methods. Refer to EA section 2.3.3.

22. **Several commenters that oppose the use of lethal PDM claim that WS-Utah should examine whether lethal control of predators is needed given the wide array of available nonlethal methods.**
WS-Utah does use and recommend nonlethal methods as part of their Integrated PDM program. Alternative 3 adequately analyzes the nonlethal PDM only Alternative.

23. **The EA fails to consider the impacts of public land livestock grazing as it relates to climate change and habitat destruction.**

WS-Utah does not regulate public land livestock grazing. Refer to section 2.5.6, 2.5.13, and 3.6.12 of the EA for further information on these topics.

24. **The EA failed to consider the impacts of WS-Utah PDM on a regional and national scale.**
    The determination of the scope of this EA is provided in section 1.6**.**

25. **Several commenters claimed that the EA fails to describe the need for preventive PDM to protect human health and safety (HHS).**
    WS-Utah does not conduct preventive PDM for HHS protection. WS-Utah responds to threats from bold or aggressive animals or after an HHS incident has taken place. WS-Utah understands these incidents are rare but they do happen and they have had extreme and fatal consequences. Refer to EA section 1.4.3 for more information on this topic.

26. **The EA fails to describe the significant risks to the public created by its PDM activities.**
    WS-Utah disagrees with this statement. Section 4.6 of the EA adequately describes the risk of PDM to Public and Pet safety for each PDM method used by WS-Utah. Each section also references the Risk Assessments for each method as they are cited in the EA.

27. **The EA blames predators for livestock aggression toward humans. There is no mention of the effects of stress introduced by human activities themselves, such as branding, medicating, breeding, and other activities that produce fear and aggression in livestock. This is not a justification for preemptive predator control.**
    The EA States the predators "may" cause livestock to become more aggressive towards humans. EA section 1.4.1.4. It does not say this is the sole reason for livestock becoming aggressive. WS-Utah does not try to justify the need for preventive PDM solely based on aggressive predators or livestock. Preventive PDM is the application of PDM strategies before damage occurs, based on historical damage problems. As requested and appropriate, WS-Utah personnel provide information and conduct demonstrations, or take action to prevent these historical problems from recurring. Refer EA section 3.3.1 for more information on this topic.

28. **Allowing traps, snares, and poisons anywhere on public land removes that area from use by the public by rendering it too dangerous for humans or pets.**
    WS-Utah disagrees with the commenters claim. WS-Utah does not regulate trapping laws. The effects of WS-Utah PDM on Public and Pet Safety is adequately analyzed in section 4.6 of the EA. The commenter’s views do not necessarily represent the majority of the general public.

29. **Commenters expressed that their views opposing PDM represent the views of the majority of the general public.**

WS-Utah disagrees with this claim. The views of independent organizations or individuals do not necessarily represent the views of the majority of the general public.

30. Hunting of cougars may increase conflicts with livestock.
WS-Utah PDM is significantly different than using hunting as a form of wildlife management at the state level. UDWR has management authority for setting seasons and harvest limits for managing wildlife populations in Utah.

31. Carnivores may increase prey kills as a result of stress from hunting.
WS-Utah PDM is significantly different than using hunting as a form of wildlife management. EA Section 4.5 further analyzes the potential effects on wildlife from stress. Not all forms of stress result in adverse consequences to the animal, and some forms of stress serve a positive or adaptive function for the animal.

32. WS-Utah claims that it will not conduct PDM in restricted zones identified and mapped by partner agencies, but fails to provide those maps in the EA or otherwise identify the areas.
WS-Utah is not obligated to provide partner agency maps of restricted use areas. Contact the appropriate land management agency for maps of restricted use areas.

33. WS-Utah fails to consider impacts to wildlife populations on a localized scale.
The determination for the scale of the analysis is addressed section 1.6.2 of the EA. 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 as explained in section 1.11.1 of the EA.

34. WS-Utah has insufficient data to accurately estimate the populations of the target species in the EA.
WS-Utah uses the best available population information and data. Estimating wildlife densities is not precise and often dynamic, and professional judgment is required to account for unknowns and variables, such as the ability of habitats to support populations and recruitment. Therefore, assessments are based on conservative population estimates rather than higher population estimates to better insure that no adverse wildlife population effects occur as described in section 4.3 of the EA.

35. The many variables influencing deer populations reduces the reliability of the analysis and the conclusion that PDM is the best way to manipulate deer populations.
The EA does not claim that that PDM is the best way to manipulate deer populations. PDM to protect game species is a complex issue that is further explained in section 1.4.2 of the EA. WS-Utah conducts PDM to protect game species at the request of UDWR.

36. WS-Utah should fully consider an Alternative of no PDM assistance on public land.

Section 3.6.3 of the EA provides a detailed description of why this Alternative was not one of the Alternatives in the EA considered in full detail.

37. **WS-Utah ignores opposing public opinion regarding lethal PDM.**
WS-Utah does not agree with this claim. WS-Utah followed all of the agency requirements for including the public in the development of this EA. Alternatives 3 and 4 were fully considered and do not include lethal PDM by WS-Utah.

38. **EA makes no indication of the extent to which WS-Utah considered opposing opinions that challenge the efficacy of lethal PDM. Where scientific uncertainty is present, WS-Utah must openly analyze the reputable opinions contrary to its proposed action.**
WS-Utah disagrees with this claim. Section 1.11.2 provides adequate analysis on the effectiveness of PDM. WS-Utah is not obligated to settle disputes regarding opposing opinions or disagreements among scientific experts. According to CEQ, only a reasoned analysis of the evidence is required.

39. **WS-Utah should use reproductive inhibitors and sterilization instead of lethal PDM.**
Refer to section 3.6.19 for information on the use of reproductive inhibitors.

40. **WS-Utah's PDM kills many unintended animals including sensitive and threatened species.**
The effects of the WS-Utah Program on sensitive, and nontarget Wildlife (including T&E and Sensitive Specie) is adequately analyzed for each alternative in the EA and a decision of finding of no significant impact was determined based on this analysis in the EA.

41. **The EA fails to adequately analyze the impacts of the WS- Utah PDM program on nontarget species.**
WS-Utah disagrees with this claim. Section 4.4 of the EA is a full analysis of the effects of WS-Utah PDM on sensitive and nontarget species. WS-Utah's decision was a finding of no significant impact from the proposed action.

42. **The only activity WS-Utah proposes to minimize the risk of taking a rare animals is to "consult with UDWR and follow pesticide label or to recover coyote carcasses "whenever practical" to keep California condors from being poisoned by lead bullets. More stringent mitigation procedures (such as banning lead shot) must be implemented in areas that might have T&E species.**
This is a false statement. Refer to section 3.5 of the EA for a list and detailed description of WS-Utah's operating policies. Section 4.4.1 and section 4.4.1.2 outlines WS-Utah's policies for reducing the risk of exposing California condors to lead.

43. **WS-Utah should stop using lead ammunition for all PDM actions throughout the state of Utah to protect the environment.**
Section 4.6.6 adequately addresses the potential impacts and risk associated from the use of lead ammunition. Refer to EA section 3.6.21 for an explanation of WS-Utah's stance on the use of non-lead ammunition.

44. **The description of the WS-Decision Model is vague and further site specific analysis is required to justify site specific actions.**
WS-Utah does not agree with this comment. Site specificity and the use of the WS-Decision Model is adequately explained in section 1.6.2 of the EA. Planning for PDM is conceptually similar to federal or other agency actions whose missions are to stop or prevent adverse consequences from anticipated future events for which the actual sites and locations where they will occur are unknown but could be anywhere in a defined geographic area.

45. **WS-Utah ignores the sociocultural value of wildlife in the EA**.
WS-Utah disagrees with this claim. The EA address many sociocultural aspects and potential impacts such as aesthetics, impacts to recreation, Special Management Areas, Tribal lands, humaneness and ethics, and many other sociocultural issues. EA Section 3.5.2.5, 2.4.2, 2.5.17, 2.3.3.

46. **WS-Utah should not conduct lethal PDM free of charge to support livestock producers at the expense of the taxpayers in Utah.**
It is a false statement that WS provides PDM free of charge to livestock producers. A combination of federal, state, and/or cooperative dollars are used to support producers. In some cases, producers may pay into a larger organization that in turn, pays WS-Utah to support its constituency. WS-Utah also considers all viable methods (lethal and nonlethal) when addressing predator damage. EA Section 2.5.10. Section 3.6.4 of the EA discusses the Alternative of No Lethal PDM at the taxpayer expense.

47. **Compensation for livestock losses instead of PDM should be fully considered in the EA.**
Section 3.6.16 provides information on compensation for livestock losses to predation.

48. **The EA fails to adequately consider the impacts of conducting its PDM activities on Utah's Wildernesses, Wilderness Study Areas, Areas of Critical Environmental Concern and other protected areas.**
WS-Utah does not agree with this comment. EA section 2.4.2 and 3.6.5 discusses PDM in wilderness areas and other sensitive areas. WS-Utah determined that their PDM actions would have no significant impact.

49. **Wildlife Services has failed to demonstrate compliance with NEPA and legislative mandates governing other special places including but not limited to National**

Recreation Areas, National Conservation Areas, National Monuments, National Historic and Scenic Routes and Trails, and Wild and Scenic Rivers.
WS-Utah disagrees with this claim. Refer to section 1.8 and 2.4.2 of the EA. WS-Utah consults with the appropriate legal authority or land management agency when conducting PDM to avoid potential impacts to any sensitive or historic areas.

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APPENDIX A: LITERATURE CITED

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APPENDIX B: WA, WSA, AND ISA IN UTAH

Wilderness Areas

National Forest Designated Wilderness

Dixie National Forest	
Ashdown George Wilderness Area*	7,000 acres
Pine Valley Mountain Wilderness Area	50,000 acres
Box-Death Hollow Wilderness Area	26,000 acres
Fishlake National Forest	
(none)	
Manti-LaSal National Forest	
Dark Canyon Wilderness Area	45,000 acres
Forest Service Total	128,000 acres

BLM Designated Wilderness

Paria Canyon	
Vermillion Cliff's Wilderness Area	110,000 acres
Beaver Dam Mountains	19,600 acres
Designated Wilderness Total	129,600 acres

Wilderness Study Areas/Instant Study Area/Primitive Areas (BLM 2013)

Behind the Rocks	13,065	Cross Canyon	599
Black Ridge Canyons West	52	Daniels Canyon	2,516
Book Cliffs Mountain Browse	399	Dark Canyon	67,825
Bridger Jack Mesa	6,333	Death Ridge	66,286
Bull Canyon	599	Deep Creek Mountains	79,144
Bull Mountain	13,138	Desolation Canyon	294,581
Burning Hills	65,710	Devils Canyon	9,142
Butler Wash	24,277	Devils Garden	633
Canaan Mountain	4,985	Diamond Breaks	3,926
Carcass Canyon	48,628	Dirty Devil	71,883
Cheesebox Canyon	14,831	Escalante Canyons Tract 1	364
Coal Canyon	60,755	Escalante Canyons Tract 5	761
Conger Mountain	20,161	Fiddler Butte	73,360
Crack Canyon	26,303	Fifty Mile Mountain	160,833

Fish Creek Canyon	46,102
Fish Springs	57,609
Floy Canyon	72,282
Flume Canyon	50,628
Fremont Gorge	2,843
French Spring-Happy Canyon	24,306
Grand Gulch	105,213
Horseshoe Canyon (North)	13,502
Horseshoe Canyon (South)	39,842
Howell Peak	27,545
Indian Creek	6,554
Jack Canyon	7,203
Joshua Tree	1,048
King Top	92,847
Link Flats	882
Little Rockies	40,733
Lost Spring Canyon	1,625
Mancos Mesa	50,889
Mexican Mountain	58,326
Mill Creek Canyon	9,866
Moquith Mountain	15,249
Mt. Ellen-Blue Hills	81,363
Mt. Hillers	19,277
Mt. Pennell	77,137
Mud Spring Canyon	40,573
Muddy Creek	30,521
Mule Canyon	6,171
Negro Bill Canyon	7,560
North Escalante Canyons/The Gulch	127,459
North Fork Virgin River	1,080
North Stansbury Mountains	10,786
Notch Peak	57,296
Orderville Canyon	1,952

Paria Hackberry 202	402
Paria Hackberry/ Paria Hackberry 202	145,426
Parunuweap Canyon	30,907
Phipps-Death Hollow	45,328
Road Canyon	52,404
Rockwell	9,342
San Rafael Reef	59,051
Scorpion	37,319
Sids Cabin 202	439
Sids Mountain	74,777
South Needles	160
Spring Creek Canyon	4,333
Spruce Canyon	20,353
Squaw/Papoose Canyon	6,560
Steep Creek	23,978
Swasey Mountain	59,006
The Blues	19,416
The Cockscomb	9,921
Turtle Canyon	33,379
Wah Wah Mountains	49,429
Wahweap	144,268
West Cold Springs	3,283
Westwater Canyon	30,066
White Rock Range	3,767
Winter Ridge	43,322

Total Acres
3,223,994

APPENDIX C: STATE SENSITITIVE SPECIES

WS-Utah

Fishes

Federal Candidate Species
(None)

Federally Threatened Species
Lehontan Cutthroat Trout (introduced) *Oncorhynchus clarkia henshawi*

Federally Endangered Species
Humpback Chub
Gila cypha
Bonytail
Gila elegans
Virgin River chub
Gila seminuda
Colorado pikeminnow
Ptychocheilus lucius
Woundfin Plagopterus argentissimus
Razorback Sucker
Xyrauchen texanus

Conservation Agreement Species
Bonneville Cutthroat Trout
Oncorhynchus clarki utah
Colorado River Cutthroat Trout
Oncorhynchus clarki pleuriticus
Virgin Spinedace
Lepidomeda mollispinis mollispinis
Least Chub *Iotichthys phlegethontis*
Roundtail Chub
Gila robusta
Bluehead Sucker
Catostomus discobolus
Flannelmouth Sucker
Catostomus latipinnis

Wildlife Species of Concern
Leatherside Chub *Gila copei*
Desert Sucker Catostomus clarki
Yellowstone Cutthroat Trout
Oncorhynchus clarkii bouvieri
Bear Lake Whitefish
Prosopium abyssicola
Bonneville Cisco
Prosopium gemmifer
Bonneville Whitefish
Prosopium spilonotus
Bear Lake Sculpin
Cottus extensus

Amphibians

Federal Candidate Species
Relict Leopard Frog (extirpated)
Rana onca

Federally Threatened Species
(None)

Federally Endangered Species
(None)

Conservation Agreement Species
Columbia Spotted Frog
Rana luteiventris

Wildlife Species of Concern
Western Toad
Bufo boreas
Arizona Toad
Bufo microscaphus

Great Plains Toad
Bufo cognatus

Reptiles

Federal Candidate Species
(None)

Federally Threatened Species
Desert Tortoise
Gopherus agassizii

Federally Endangered Species
(None)

Conservation Agreement Species
(None)

Wildlife Species of Concern
Zebra-tailed Lizard
Callisaurus draconoides
Western Banded Gecko
Coleonyx variegatus
Desert Iguana
Dipsosaurus dorsalis
Gila Monster
Heloderma suspectum
Common Chuckwalla
Sauromalus ater
Desert Night Lizard
Xantusia vigilis
Sidewinder
Crotalus cerastes
Speckled Rattlesnake
Crotalus mitchellii
Mojave rattlesnake
Crotalus scutulatus
Cornsnake
Elaphe guttata
Smooth Greensnake
Opheodrys vernalis
Western Threadsnake
Leptotyphlops humilis

Birds

Federal Candidate Species
(none)
Federally Threatened Species
Gunnison Sage-grouse
Centrocercus minimus (Gunnison sage-grouse is a Federal Threatened Species and a Conservation Agreement Species)
Mexican Spotted Owl
Strix occidentalis lucida
Yellow-billed Cuckoo
Coccyzus americanus

Federally Endangered Species
California Condor (experimental)
Gymnogyps californianus
Whooping Crane (extirpated)
Grus americana
Southwestern Willow Flycatcher
Empidonax traillii extimus

Conservation Agreement Species
Northern Goshawk
Accipiter gentiles

Wildlife Species of Concern
Bald Eagle
Haliaeetus leucocephalus
Grasshopper Sparrow
Ammodramus savannarum
Short-eared Owl
Asio flammeus
Burrowing Owl
Athene cunicularia
Ferruginous Hawk
Buteo regalis

Greater Sage-grouse
Centrocercus urophasianus
Black Swift
Cypseloides niger
Bobolink
Dolichonyx oryzivorus
Lewis's Woodpecker
Melanerpes lewis
Long-billed Curlew
Numenius americanus
American White Pelican
Pelecanus erythrorhynchos
Three-toed Woodpecker
Picoides tridactylus
Sharp-tailed Grouose
Tympanuchus phasianellus
Mountain Plover
Charadrius montanus

Mammals

Federal Candidate Species
(None)

Federally Threatened Species
Utah prairie-dog
Cynomys parvidens
brown/grizzly bear (extirpated)
Ursus arctos
Canada Lynx
Lynx canadensis

Federally Endangered Species
Black-footed Ferret
(experimental, non-essential in Duchesne and Uintah counties)
Mustela nigripes
Gray Wolf
Canis lupus

Conservation Agreement Species
(None)

Wildlife Species of Concern
Preble's Shrew
Sorex preblei
Townsend's Big-eared Bat
Corynorhinus townsendii
Spotted Bat
Euderma maculatum
Allen's Big-eared Bat
Idionycteris phyllotis
Western Red Bat
Lasiurus blossevillii
Fringed Myotis
Myotis thysanodes
Big Free-tailed Bat
Nyctinomops macrotis
Pygmy Rabbit
Brachylagus idahoensis
Gunnison's prairie-dog *Cynomys gunnisoni*
White-tailed Prairie-dog
Cynomys leucurus
Silky Pocket Mouse
Perognathus flavus
Dark Kangaroo Mouse
Microdipodops megacephalus
Mexican vole
Microtus mexicanus
Kit Fox
Vulpes macrotis

Mollusks

Federal Candidate Species
(None)

Federally Threatened Species
(None)

Federally Endangered Species
Kanab Ambersnail
Oxyloma kanabense

Conservation Agreement Species

(None)

Wildlife Species of Concern

Eureka Mountainsnail
Oreohelix eurekensis
Brian Head Mountainsnail
Oreohelix parawanensis
Yavapai Mountainsnail
Oreohelix yavapai
Cloaked Physa
Physa megalochlamys
Utah Physa
Physella utahensis
Wet-rock Physa
Physella zionis
Longitudinal Gland Pyrg
Pyrgulopsis anguina
Smooth Glenwood Pyrg
Pyrgulopsis chamberlini
Desert Springsnail
Pyrgulopsis deserta
Otter Creek Pyrg
Pyrgulopsis fusca
Hamlin Valley Pyrg
Pyrgulopsis hamlinensis
Carinate Glenwood Pyrg
Pyrgulopsis inopinata
Ninemile Pyrg
Pyrgulopsis nonaria
Bifid Duct Pyrg
Pyrgulopsis peculiaris
Black Canyon Pyrg
Pyrgulopsis plicata
Sub-globose Snake Pyrg
Pyrgulopsis saxatilis
Southern Bonneville Pyrg
Pyrgulopsis transversa
California floater
Anodonta californiensis
Western Pearlshell
Margaritifera falcate
Southern Tightcoil
Ogaridiscus subrupicola
Lyrate Mountainsnail
Oreohelix haydeni
Deseret Mountainsnail
Oreohelix peripherica
Bear Lake Springsnail
Pyrgulopsis pilsbryana
Northwest Bonneville Pyrg
Pyrgulopsis variegate

Adapted from the State of Utah, Department of Natural Resources, Division of Wildlife Resources sensitive species sist dated October 1, 2015

Appendix D: RESPONSE TO 2016 EVALUATION OF PREDATOR CONTROL STUDIES BY DR. ADRIAN TREVES, MIHA KROFEL, AND JEANNINE MCMANUS.

On September 1, 2016, researchers from the University of Wisconsin-Madison*, University of Ljubljana, and University of Witwatersrand released a publication entitled "Predator control should not be a shot in the dark" (Treves et al. 2016). The researchers evaluated 12 existing publications (5 nonlethal and 7 lethal methods) regarding the effectiveness of nonlethal and lethal methods for reducing predation on livestock. Their main conclusions included the following:

1. Predator control methods to prevent livestock loss have rarely been subject to rigorous tests using the "gold standard" for scientific inference (random assignment to control and treatment groups with experimental designs that avoid biases in sampling, treatment, measurement, or reporting)
2. Across the controlled experiments that they systematically examined, higher standards of evidence were generally applied in tests of nonlethal methods than in tests of lethal methods for predator control
3. Nonlethal methods were more effective than lethal methods in preventing carnivore predation on livestock generally; at least two lethal methods (government culling or regulated, public hunting) were followed by increases in predation on livestock; zero tests of nonlethal methods had counterproductive effects
4. All flawed tests came from North America; ten of 12 flawed tests were published in three journals, compared to four of 12 tests with strong inference in those same journals
5. Treves et al. (2016) recommend suspending lethal predator control methods that do not currently have rigorous evidence for functional effectiveness in preventing livestock loss until gold standard tests are completed.

Specific Points Regarding Treves' Article:

•Treves et al. (2016) recommend wildlife researchers apply the same standards used in controlled, laboratory settings to wildlife field research. Such standards (which involve randomized, controlled trials) are often not possible in field studies for a variety of reasons:

- First, it can be difficult to find comparable units for evaluation. In the case of predation management, finding multiple field study sites that not only prohibit predator control, but also allow ranching, is difficult. Almost by definition, ranchers with high predation rates usually try to control predators, and ranchers with minimal problems do not.

- Second, field studies involve a lot of variation. There are many factors from the weather to varying habitats to the movement of wildlife in and out of study areas that cannot be controlled and may impact results. This is the inherent nature of field work.
- Finally, to give sufficient statistical power, sample sizes must be large. Gathering sufficient data often involves multiple field seasons and field experts. Funding and other resources can limit the ability to conduct such studies.

•To conduct a completely randomized design as suggested by Treves et al. (2016) would result in inherently large variability among sites and would necessitate such a large sample size that it would not be possible or practical in most instances. Two alternative field designs that are commonly used in wildlife research include a switch-back and paired block approach.

- In the case of a predator control study, a switch-back design would involve at least two study areas, one (or more) with predator control and one (or more) without predator control. After at least 2 years of data collection, the sites would switch so that the one with predator control becomes the one without predator control and vice versa. An additional 2 years of data collection would occur. Wildlife Services researchers are currently involved in a controlled switch-back study like the one described above that is investigating the effectiveness of coyote control for reducing predation on deer populations in Utah.
- The paired block design, involves finding multiple sites that are similar that can be paired and compared. For each pair, one site would experience predator control and one would not.

•Treves et al.'s sloppy assessment of existing predation studies from North America and Europe causes us to question his ability to accurately critique the scientific literature. Treves et al.'s critique of a least two of the studies reviewed in their paper did not accurately interpret or represent the studies' designs and results.

- In regards to Wagner and Conover (1999), Treves et al. (2016) makes a fundamental error in interpreting the study design. When researchers make changes to the independent variable, they measure the changes in the dependent variable. The purpose of the study was to determine the impact of preventive aerial operations (independent variable) as currently practiced by the WS program on sheep losses the following summer (dependent variable) and the need for subsequent corrective predator damage management (i.e., the use of traps snares and M-44s - also a dependent variable) during the subsequent summer. Treves et al. (2016) mistakenly characterize use of traps, snares and M-44s as independent variables which indicates a fundamental inattentiveness to the details of the study. This error led the authors to erroneously claim a variation that occurred in response to the treatment was either a willful misapplication of a control variable or a gross failure in study design. Wagner and Conover

(1999) purposefully allowed corrective predator damage management to be conducted during the summer following aerial operations because, as practiced, it was highly improbable that preventive aerial operations would ever be used to the exclusion of all other methods for corrective predator damage management. Furthermore, if preventive aerial operations were effective, authors predicted one of two outcomes:

1) losses on areas without aerial operations would be lower than losses in areas with aerial operations and there would be a corresponding decrease in use of traps, snares and M-44s; or,
2) increased use of corrective predation management during the summer could be sufficient to keep losses at levels similar to areas with preventive aerial operations, but the amount of summer corrective predation damage management would be higher in areas without aerial operations.

Traps, snares and M-44s pose substantially different risks to nontarget species than aerial operations. Wagner and Conover (1999) felt that this information was important when making management decisions regarding the use of preventive aerial operations.

Treves et al. (2016) also states that the study is biased because "control pastures started with 40% higher sheep densities." However, Treves et al.'s calculation of sheep densities was based on incomplete information and is not a valid interpretation of the density of sheep during the study period. In the study, sheep were not permitted to disperse evenly throughout the grazing allotments, instead, herders move sheep bands through subsections of the allotments in accordance with established grazing management plans. Consequently, simply dividing the number of sheep on the allotment by the total size of the allotment, as was done, does not accurately reflect the density of sheep during the study.

Treves et al. states the study includes a reporting bias because "data was not presented" on livestock-guarding dogs. Wagner and Conover (1999) clearly states that one of the criterion used for pairing allotments was the presence or absence of livestock guarding dogs (LGD). They did not pair allotments with LGDs with allotments without LGDs. Failure to provide data showing that that number of treated allotments with LGDs matched the number of untreated allotments with LGDs does not constitute a reporting bias.

Treves et al. misrepresents another study conducted by Dr. Eric Gese (WS-NWRC) and a Utah State University collaborator on a study site in western Wyoming. Treves et al. confuses two different studies when citing Bromley and Gese (2009) on page 23. The Bromley and Gese (2001a, 2001b) study examined coyote predation on domestic sheep; in contrast, the Seidler and Gese (2012) study examined coyote predation on pronghorn fawns. While citing Bromley and Gese (2009), Treves et al. (2016) is actually referring to a paper published in 2001 (Bromley and Gese 2001a). As a reason for study bias, they mention that Bromley and Gese's study includes a high overlap between coyote territories.

The statistics mentioned actually come from a completely different study (Seidler and Gese 2012) that was conducted in a different State (southeastern Colorado), 7 years later, and in a completely different system (i.e., no sheep). The Bromley and Gese (2001b) publication actually reports that coyote core areas overlapped only once (by 3%) and there was no significant difference in overlap among sterile and intact coyote packs. In fact, to eliminate a potential inaccurate assignment of the coyotes responsible for making a kill, Bromley and Gese used the actual locations of the radioed coyotes as the method of assigning which pack killed the sheep whenever there was overlap of territory boundaries between adjacent packs.

Additionally, Treves et al. incorrectly states that the estimates of weekly survival rates are not biologically significant. However, they used data from all the packs which is inappropriate as not all packs killed sheep. By only using data from sheep-killing packs and doing some simple math, they would have concluded that a weekly survival rate of 0.997 in the sterile packs equates to 94% of the lambs surviving for the next 6-months (beyond which they are no longer vulnerable to predation), versus a weekly survival rate of 0.985 in the intact packs which equates to 72% of the lambs surviving for the next 6 months. Therefore, sterilization would provide 22% higher survival of lambs which is quite biologically and economically significant to a livestock producer.

The correct references are:

Bromley, C., and E. M. Gese. 2001a. Surgical sterilization as a method of reducing coyote predation on domestic sheep. Journal of Wildlife Management 65(3):510-519.

Bromley, C., and E. M. Gese. 2001b. Effects of sterilization on territory fidelity and maintenance, pair bonds, and survival rates of free-ranging coyotes. Canadian Journal of Zoology 79(3):386-392.

Treves et al. (2016) include a paper by (Musiani et al. 2003) whereby they claim fladry (a method for controlling wolves) was experimentally tested. But in fact the experimental portion of the work was done on captive animals. The two field trials included in the paper did not meet the scientific standards outlined by Treves. This was either purposefully deceptive or sloppy.

Treves et al. (2016) selectively disregards studies from Australia. These studies are some of the more rigorous field studies on working livestock operations with free-ranging, native carnivores that evaluate the effectiveness of lethal control. Given their explicit desire to make generalization about predation control, it is odd that they would purposefully exclude this body of rigorous science.

WS understands and appreciates interest in ensuring predator damage management methods are as robust and effective as possible. WS supports the use of rigorous, scientifically-sound studies, but we realize there are many variables that cannot be controlled and assumptions that must be acknowledged when trying to answer complex ecological questions. We do not believe there is a single standard for conducting wildlife field studies and each approach or design has its own unique assumptions, drawbacks and challenges. WS does not believe that results from existing studies should be ignored. Wildlife research is inherently challenging because scientists are not working in a "closed" system. Science and the scientific method are a process. You build upon information gathered over years of study and experimentation. Results from one study lead to new questions and new studies.

WS' policies and decisions are based on the best available science. The National Environmental Policy Act (NEPA) requires federal agencies to evaluate environmental impacts into their decision making processes and ensures that environmental information is available to public officials and citizens before decisions are made and actions are taken. To fulfill this responsibility, Wildlife Services prepares analyses of the environmental effects of program activities as part of the NEPA process. A description of and citations for various wildlife damage management actions can be found in the program's Environmental Assessments and Environmental Impacts Statements which are available by State on the APHIS website.

Wildlife Services encourages the use of nonlethal predation damage management tools and techniques when feasible and practical, however, not all wildlife damage problems can be resolved using nonlethal techniques alone. Even with the use of single or combined nonlethal methods, livestock losses to predators often continue. When conducting lethal management activities, Wildlife Services evaluates all potential tools for humaneness, effectiveness, ability to target specific individual animals and/or species, and the potential impact on human safety. Professional organizations such as The Wildlife Society (TWS), whose 10,000 members include scientists, managers, educators and others, have long supported the use of lethal take. TWS's Standing Position Statement on Wildlife Damage Management states, "Prevention or control of wildlife damage, which often includes removal of the animals responsible for the damage, is an essential and responsible part of wildlife management." It is important to note that Wildlife Services is tasked with reducing wildlife damage. We do not manage wildlife populations. The management of predators and other wildlife is the responsibility of the States and other federal agencies. As such, any actions undertaken to reduce wildlife damage are conducted in collaboration with State agencies and under appropriate State and federal permits and laws.

Appendix E: PDM Methods and Techniques Available Used in the Current WS-Utah PDM Program.

Introduction

WS-Utah works with federal, state, local agencies, private individuals, and associations to protect livestock, poultry, natural resources, property, and human safety from wildlife threats and damages. WS-Utah conducts technical assistance (education, information, and advice) and operational wildlife damage management when requested.

Federal, state, tribal, and local regulations and APHIS-WS Directives govern APHIS-WS' use of damage management tools. The following methods and materials are recommended or used in technical assistance and operational damage management efforts of the WS-Utah program. See Section 4.5 for a detailed discussion on humaneness of various IPDM methods.

What Non-Lethal IPDM Methods Are Available to WS-Utah

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-Utah are also available to other entities within the state and could be used by those entities to damage. Depending on the method, the cooperator and/or the WS-Utah employee may implement it. Livestock producers and property owners are encouraged by WS-Utah to use non-lethal methods to prevent damage.

Each non-lethal method described below identifies its possible application as technical assistance and/or operational assistance.

Education: Technical Assistance

Education is an important element of IPDM activities and facilitates coexistence between people and wildlife. In addition to providing recommendations and information to entities experiencing damage, APHIS-WS provides lectures, courses, 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.

Physical Exclusion: Technical Assistance

Physical exclusion methods can sometimes prevent predators from accessing valuable resources. Woven wire and other types of more permanent fencing, especially if it is installed with an underground skirt, can prevent many predator species that burrow, including coyotes, foxes, badgers, feral cats, and striped skunks. Areas such as airports, yards, or hay meadows may be fenced. Hardware cloth or other metal barriers can sometimes be used to prevent girdling and peeling of valuable trees or patch holes or gaps in existing structures. Entrance barricades are used to exclude bobcats, coyotes, foxes, opossums, raccoons, or skunks from dwellings, storage areas, gardens, or other areas.

Temporary fences, such as electric polytape fence or fladry fencing, are often used to protect livestock in temporary pastures, as night pens for sheep, or for protection of small pastures. These systems may need to be maintained or moved frequently to avoid malfunctions or predator habituation.

Predator-proof fencing may be effective in confined situations or for protecting extremely high-value animals. These fences are designed with sufficient height and depth to prevent predators from jumping over or digging under. The initial cost of constructing a predator-proof fence often discourages their use, but may be economically practicable in small areas, such as calving grounds and bedding areas.

Electric fences have been used effectively to reduce predator damage to crops 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.

Animal Husbandry: Technical Assistance

Animal husbandry practices may minimize livestock exposure to predators. Animal husbandry includes actions such as modifications in the level of care and attention given to livestock, shifts in the timing of breeding and births, selection of less vulnerable livestock species, and introduction of human and animal custodians to protect livestock. The duration of animal husbandry techniques may range from daily to seasonal. Generally, as the frequency and intensity of livestock handling increases, so does the degree of protection, since the risk of depredation is greatest when livestock are left unattended.

Shifts in breeding schedules can reduce the risk of depredation by altering the timing of births to coincide with the greatest availability of natural prey to predators or to avoid seasonal concentrations of migrating predators. Hiring extra herders, building secure holding pens, and adjusting the timing of births may be expensive, but effective. The timing of births is often related to weather or seasonal marketing of young livestock, and therefore shifts in breeding schedules may not always be feasible.

Herders and range riders are often used by producers to monitor sheep and cattle pastures for the presence of predators. Herders and range riders employee a variety of non-lethal methods, such as carcass removal, guard dogs, propane cannons, non-lethal projectiles, and animal husbandry. Work often occurs during the day and night to effectively deter predators.

Pasture selection involves moving livestock to areas less susceptible to predation events, such as pastures near man-made structures. The risk of depredation diminishes as age and size increase and can be minimized by holding expectant females and newborn livestock in pens. Nightly gathering may not be possible where livestock are in many fenced pastures or where grazing conditions require livestock to scatter.

Behavior selection of livestock is 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, Kangal, and Komondor, have been effective in protecting livestock from coyote predation in the United States. Guard donkeys have been used to deter dog and coyote predation with varied success. Guard llamas readily bond with sheep and are can reduce coyote predation. All technical assistance regarding guard dogs is conducted in compliance with WS Directive 2.440 (Section 2.4 A13).

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-Utah only provides advice on the type of modifications that have the best chance of achieving the desired effect. WS-Utah advises landowners/managers that they are responsible for compliance with all applicable regulations related to habitat management, including the Endangered Species Act.

Architectural design can often help to avoid potential predator damage. For example, incorporating open areas into landscape designs that expose animals may significantly reduce potential problems. Additionally, selecting species of trees and shrubs that are not attractive to wildlife can reduce the likelihood of potential predator damage to parks, public spaces, or residential areas.

Managing the habitat, such as minimizing cover, planting lure crops, and tree removal, can sometimes reduce damage associated with predators that use vegetation and crops for foraging and hiding. Habitat management is a primary strategies at airports to reduce aircraft damage and protect human safety. Generally, many problems associated with predator 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 near homes, buildings, 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.

Modifying Animal Behaviors: Technical and/or Operational Assistance

Modifying animal behaviors involves techniques aimed at causing target animals to flee or remaining at a distance. Frightening and harassment devices are one of the oldest and most popular methods of reducing wildlife damage and depend on the animal's aversion to offensive stimuli. These methods usually use extreme and random noise or harassment and should be changed frequently as wildlife usually become habituated to scare devices. Motion-activated systems may also extend the effective period for a frightening devices. These techniques tend to be more effective when used in a strategy involving the use of multiple methods. However, their continued success may require reinforcement by limited lethal shooting to avoid habituation.

Electronic distress sounds and alarm calls are electronic devices that broadcast recorded or artificial wildlife distress sounds in the immediate area and are intended to cause a flight response from specific species. These sounds may be used alone or in conjunction with other scaring devices. Animals react differently to distress calls so their use depends on the species and problem. Calls may be played for short bursts, long periods, or even continually, depending on the severity of damage and relative effectiveness of different treatment or "playing" times. These calls can be used in urban effectively and without excessively disturbing humans.

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-Utah employees receive safety training in transporting, using, and storing pyrotechnics, as required by WS Directives 2.615 and 2.625 (Section 2.4 A3, A4). When pyrotechnics are recommended during technical assistance, WS-Utah provides pyrotechnics safety information and instructions to the user.

Electronic Guard (siren strobe-light devices), developed by APHIS-WS NWRC, is a battery-powered unit operated by a photocell that emits a flashing strobe light and siren call at intervals throughout the night. Efficacy of strobe-sirens is highly variable and typically lasts less than three weeks, but in certain situations, has been used successfully to reduce coyote and bear depredation on sheep. The device is a short-term tool used to deter predation until livestock can be moved to another pasture, brought to market, or other IPDM methods are implemented. This technique is most successful at bedding grounds where sheep gather at night and may be used in rural or urban settings.

Visual scaring techniques such 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.

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-Utah 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.

Aerial hazing/harassment/dispersal techniques use the noise and visual presence of fixed-wing aircraft or helicopters to discourage wildlife from congregating near livestock or other resources. Aerial hazing may be used in combination with other non-lethal methods, such as non-lethal projectiles, to further discourage wildlife. Aviation safety and operations SOPs are provided in WS Directive 2.620 (Section 2.4 A11) and APHIS-WS Aviation Rules (WS 2009). All efforts are conducted in strict compliance with the APHIS-WS Aviation and Safety Manual, the Federal Aviation Regulations, applicable State and local laws and regulations, Aviation Safety Plans, Aviation Communication Plans, and Aviation Emergency Response Plans.

Live-Capture and Relocation: Operational Assistance

Live-capture and relocation, when not legally prohibited by state and local law, can be used by WS-Utah personnel, per WS Directive 2.501 (Section 2.4 A7). WS-Utah only relocates predators at UDWR's direction and coordinates capture, transportation, and selection of relocation sites with the UDWR. 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.

What IPDM Methods That May be Either Lethal or Non-Lethal Are Available to WS-Utah

WS-Utah specialists can use a variety of devices to capture predators. Methods such as cage traps, cable restraints, and trained pursuit dogs are used to non-lethally capture predators, but can be used lethally depending on the circumstance. For instance, WS-Utah 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 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, Section 2.4 A2) 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 UDWR, landowners, and their agents, as approved methods for IPDM or regulated fur trapping.

Cage/box traps are live-capture traps for capturing small mammals such as skunks, feral cats, opossum, and raccoons. Cage traps come in a variety of sizes and are generally made of galvanized wire mesh, metal, plastic, or wood, and consist of a treadle inside the baited cage that triggers the door to close behind the animal being captured, preventing exit. Cage traps can range in size from small traps intended for the capture of smaller mammals to large corral/panel traps fitted with a routing or saloon-style repeating door, used to live-capture larger animals. Cage traps are species selective based on trap size which can physically exclude non-target animals. Traps are sometimes baited or set near signs of damage, known travel areas, or wildlife entrances to buildings or dens. Non-target animals are generally released with little or no injury. An adequate supply of food and water is placed in the trap to sustain captured animals for several days, but traps are typically checked more regularly. Cage traps are available to all entities to alleviate damage and can be purchased commercially.

Culvert traps are a type of large, baited, live-capture cage trap for large mammals. These traps have trigger systems attached to gravity doors, and are constructed of solid sheet metal on a wheeled platform or trailer. APHIS-WS most often uses this type of trap for black bears in urban/suburban settings, but culvert traps can also be used in rural areas and for other species. APHIS-WS 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 UDWR.

Quick-Kill/Body Gripping Traps are used by APHIS-WS to capture various mammals, such as raccoons, skunks, red foxes, 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. 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, Section 2.4 A2).

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-Utah 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 (Sections 2.4 A2 and A1).

Dog-proof/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 dog-proof 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 dog-proof 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-Utah follows the laws and regulations regarding the setting and checking of traps and snares as follows per APHIS-WS Directive 2.450 and 2.210 (Sections 2.4 A2 and A1).

Cable restraints (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, wire, or monofilament line with a locking device, and are used to catch small- and medium-sized predators by the neck, body, or foot. Snares can be used effectively on animal travel corridors, such as under fences or trails through vegetation.

When an animal steps into the cable loop place horizontally on the ground, a spring is triggered, and the cable tightens around the foot to hold the animal. If the snare is placed vertically, the animal walks into the snare and the neck or body is captured or entangled. On standard cable snares, snare 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 either opening or closing beyond a minimum or maximum loop circumference, which can effectively excluding non-target animals or allow for live-captures of target animals.

Most snares are also equipped with a swivel to minimize injuries to the captured animal and reduce twisting and breakage of the snare cable. Breakaway devices can also be incorporated into snares, 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 restraints 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 restraints are available to all entities to alleviate damage within state law. Snares offer several advantages over foothold traps by being lighter to transport or carry and not being as affected by inclement weather.

Trap monitors are devices that send a radio signal to a receiver if a set trap is disturbed, alerting field personnel that an animal may be captured. Trap monitors can be attached directly to the trap or attached to a wire and placed away from the trap. When the monitor is hung above the ground, it can be transmit a signal for several miles, depending on the terrain. There are many benefits to using trap monitors, such as saving considerable time when checking traps, decreasing fuel usage, prioritizing trap checks, and decreasing the need for human presence in the area. By using trap monitors to prioritize trap checks, the amount of time a captured animal is restrained is decreased, minimizing pain and stress and allowing non-target animals to be released in a timely manner.

APHIS-WS continues to review trap monitoring systems that are commercially available (USDA 2007, 2013), 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-Utah 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-Utah and other certified entities.

Trained pursuit dogs are used by UDWR (and their agents) and APHIS-WS (per state law) for coyote, cougar, and bear damage management activities on both private and public lands, typically in rural settings. Pursuit dogs are trained to follow the scent of the target species and can be used to find coyote dens, decoy coyotes, and pursue problem bears and cougars. Once the target animal is located by the pursuit dogs, field personnel use dart guns or firearms to euthanize the animal or immobilize for release. Pursuit dogs are always accompanied by field personnel and are redirected if found to be following the tracks or scent of non-target animals. Trained dogs are especially effective at indicating where predators have traveled, urinated, or defecated, which may be useful for setting cable restraints or traps and increase the certainty of capturing the target species.

Per WS Directive 2.445 (Section 2.4 A14), 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.

What Lethal IPDM Methods Are Available to WS-Utah

Aerial PDM: Technical Assistance or Operational Assistance

Aircraft, both fixed-wing and rotary-wing (helicopters) are used by WS-Utah for removing coyotes or feral swine. The most frequent aircraft used for aerial PDM and harassment is the fixed-wing aircraft Piper PA-18 Super Cub ad CubCrafters CC-18 Top Cub and rotary-wing Hughes MD500. WS-Utah conducts aerial activities on areas only under signed agreement or federal Annual Work Plans, and concentrates efforts to specific areas during certain times of the year.

Aerial PDM consists of visually sighting target animals in the problem area and shooting them with a firearm from an aircraft. Aerial PDM is species-specific and can be used for immediate damage relief, providing that weather, topography and ground cover conditions are favorable. Aerial PDM 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 PDM 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 PDM typically occurs in remote areas with low densities of tree or vegetation cover, where the aerial visibility of target animals is greatest. WS-Utah spends relatively little time flying and shooting over any one area.

The APHIS-WS program aircraft-use policy (WS Directive 2.620, Section 2.4 A11) and APHIS-WS Aviation Rules (WS 2009) help ensure that aerial PDM 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-Utah activities through contract, agreement, or volunteer, shall have been approved by the office of the APHIS-WS National Aviation Coordinator (NAC). WS Directive 2.615 (Section 2.4 A3) 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-Utah and APHIS-WS NWRC 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.

Ground Shooting: Technical or Operational Assistance

WS-Utah 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, as well as airports for health and human safety. Shooting is sometimes used as one of the first lethal damage management options because it offers the potential of resolving a problem quickly and selectively. Shooting is limited to locations where it is legal and safe to discharge a weapon.

Calling and shooting is a technique which uses electronic devices that broadcast recorded or artificial wildlife sounds in the immediate area and are intended to draw specific species to an area where they can be lethally removed with a firearm. Animals react differently to these calls so their use depends on the species and problem. Calls are often played for short bursts and cause minimal disturbance.

A handgun, shotgun, air gun, or rifle may be utilized. In addition, a spotlights, night vision, thermal imagery for night shooting, decoy dogs, predator calling, stalking, and/or baiting may be used to increase ground shooting efficiency and selectiveness. Spotlights are often covered with a red lens which nocturnal animals may not be able to see, making it easier to locate them undisturbed. Night shooting may be conducted in sensitive areas that have high public use or other activity during the day, which would make daytime shooting unsafe. The use of night vision and Forward Looking Infrared (FLIR) devices can also be used to detect and shoot predators at night. Coyotes and red foxes that may be trap-wise and therefore difficult to trap, are often responsive to simulated predator calling.

To ensure safe use and awareness, APHIS-WS employees who use firearms to conduct official duties are required to attend an approved firearms safety and use training program within three months of their appointment and a refresher course annually thereafter (WS Directive 2.615, Section 2.4 A3). The use and possession of firearms must be in accordance with federal, state, and local laws and regulations (also WS Directive 2.210, Section 2.4 A1). 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-Utah complies with state laws, statutes, and UDWR 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.

UDWR, commercial operators, and landowners/resource owners can also use ground shooting for IPDM, in compliance with state laws and regulations.

Carcass Disposal: Technical Assistance or Operational Assistance

Carcass disposal methods are dependent on the species. WS-Utah disposes of carcasses according to WS Directives 2.515 and 2.510 (Section 2.4 A8). Predator carcasses are disposed of in approved carcass disposal sites on public or private lands or on-site where captured. WS-Utah does not bury predator carcasses.

What Lethal and Non-lethal Chemical Methods are Available to WS-Utah

Chemical Repellents (Non-lethal): Technical and Operational Assistance

Chemical repellents are usually naturally-occurring substances or formulated chemicals that are distasteful or to elicit temporary pain or discomfort for target animals when they are smelled, tasted, or contacted. Effective and practical chemical repellents should be non-toxic to target predators, other wildlife, plants, and humans; resistant to weathering; easily applied; and highly effective.

The reaction of different animals to a particular chemical varies, and for many species there may be variations in repellency between different habitat types. Effectiveness depends on the resource to be protected, time and length of application, and sensitivity of the species causing damage. Repellents are not available for many species that may cause damage problems. Chemicals are not used by WS-Utah on public or private lands without authorization from the land management agency or property owner or manager.

Chemical Fumigants (Lethal): Operational Assistance

Denning is the practice of locating coyote, fox, and skunk dens and killing the young and/or adults by using a registered gas fumigant cartridge. This method used to manage present depredation of livestock by coyotes, fox, and skunks or anticipated depredation from coyotes. When the adults are killed and the den site is known, denning is used to euthanize the pups and prevent their starvation. Denning is highly selective for the target species responsible for damage. Den hunting for coyotes and red foxes is often combined with other damage management activities such as aerial PDM 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-Utah 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” (Section 2.6 A11). The gas cartridges used for denning (EPA Reg. No. 56228-21, EPA Reg. No. 56228-2) are registered by WS-Utah with UDAF. All pesticides used by WS-Utah are registered under the FIFRA and administered by EPA and UDAF. All WS-Utahpersonnel who apply restricted-use pesticides are state-certified pesticide applicators and have specific training by WS-Utah for pesticide application per WS Directive 2.465 (Section 2.4 A5).

What Tranquilizer and Immobilization Methods are Available to WS-Utah

Tranquilizer and immobilization chemicals may be used by WS-Utah to aid in the humane handling of predators to avoid injury to the handler and the predator. Immobilization agents can eliminate pain and reduce stress of animals while being handled. Immobilizing agents are delivered to the target animal with a dart gun or syringe pole, depending on the circumstances and the species being immobilized. WS-Utah 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 (Section 2.4 A9) 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.

Capture-All 5™ is a combination of Ketaset™ and Xylazine, and is regulated by the FDA as an investigational new animal drug. The drug is available through licensed veterinarians to individuals sufficiently trained in the use of immobilization agents. Capture-All 5™ is administered by intramuscular injection; it requires no mixing, and has a relatively long shelf life without refrigeration, all of which make it ideal for the sedation of various species.

Telazol™ is a combination of equal parts of tiletamine hydrochloride and zolazepam hydrochloride, and is a powerful anesthetic for larger animals, such as bears, coyotes, and cougars (Fowler and Miller 1999). Telazol™ produces dissociative unconsciousness, which does not affect the reflexes needed to sustain life, such as breathing, coughing, and swallowing. Following a deep intramuscular injection of Telazol™, onset of anesthetic effect usually occurs within 5 to 12 minutes. Muscle relaxation is optimum for about the first 20 to 25 minutes after administration, and then diminishes. Recovery varies with the age and physical condition of the animal and the dose of Telazol™ administered, but usually requires several hours. Although the combination of Ketamine HCl and Xylazine are effective, WS-Oregon prefers to use Telazol™ for most of the species that are immobilized.

What Euthanasia Methods are Available to WS-Utah

During IPDM activities, most captured animals are euthanized since predators rarely are permitted to be immobilized and relocated (Section 1.12.1). 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, Section 2.4 A9). 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-Utah operational assistance. Physical euthanasia methods can be used by landowners in accordance with applicable laws and regulations, and can be recommended during technical assistance.

Chemical and Gas Euthanasia Methods (Lethal): Operational Assistance

Depending on the species, the following euthanizing drugs and gases (AVMA 2013) can be used by WS-Utah and are under the jurisdiction of FDA and/or DEA. WS-Utah personnel are trained and certified to use, record, and store euthanizing drugs in accordance with DEA and state regulations.

Sodium pentobarbital is a barbiturate that rapidly depresses the central nervous system to the point of respiratory arrest. Barbiturates are a recommended euthanasia drug for free-ranging wildlife (AVMA 2013). Sodium pentobarbital would only be administered after target animals were live-captured and properly immobilized to allow for direct injection. All animals euthanized using sodium pentobarbital and its dilutions (such as Beuthanasia-D™ and Fatal-Plus™) are disposed of at approved carcass disposal sites.

Beuthanasia®-D and Euthasol® contain two active ingredients (sodium phenytoin and sodium pentobarbital) which are chemically compatible but pharmacologically different. When administered intravenously, sodium pentobarbital produces rapid anesthetic action followed by a smooth and rapid onset of unconsciousness. When administered intravenously, sodium phenytoin produces toxic signs of cardiovascular collapse and/or central nervous system depression, and hypotension can occur when the drug is administered rapidly. Sodium phenytoin exerts its effects during the deep anesthesia stage caused by sodium pentobarbital. Sodium phenytoin hastens the stoppage of electrical activity in the heart, causing a cerebral death in conjunction with and prior to respiratory arrest and circulatory collapse. This sequence of events leads to a humane, painless and rapid euthanasia (Schering-Plough Animal Health 1999). Beuthanasia®-D and Euthasol® are regulated by the DEA and the FDA for rapid and painless euthanasia of dogs, but legally may be used on other animals if the animal is not intended for human consumption (WS Directive 2.430, Section 2.4 A9).

Fatal-Plus® combines sodium pentobarbital with other substances to hasten cardiac arrest. Intravenous use is the preferred route of injection, however intra-cardiac injection is acceptable as part of the two-step procedure used by WS-Utah. Animals are first anesthetized and sedated using a combination of Ketamine/Xylazine and, once completely unresponsive to stimuli and thoroughly sedated, Fatal-Plus® is administered.

Potassium chloride, a common laboratory salt, is intravenously injected as a euthanizing agent after an animal has been anesthetized (WS Directive 2.430, Section 2.4 A9).

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-Utah uses CO_2 to euthanize wildlife which have been captured in cage traps, by hand, or by chemical immobilization. Live animals are placed in a container and CO_2 gas from a cylinder is released into the container. The animals quickly expire after inhaling the gas. This method of euthanasia is appropriate for small predators, such as skunks and raccoons, and could be effective in urban/suburban areas where use of a firearm is not appropriate.

Carbon monoxide (CO) is one of the gaseous byproducts from M-44 devices. Carbon monoxide is poisonous to all animals that use hemoglobin to transport oxygen from the lungs to the cells of the body. Carbon monoxide prevents the binding of oxygen to blood cells, causing a decrease in oxygen to cells throughout the body, resulting in asphyxiation. CO induces the loss of consciousness without pain and with minimal discomfort. Death occurs rapidly at low concentrations.

Physical Euthanasia Methods: Technical or Operational Assistance

Cervical Dislocation is sometimes used to euthanize small predators which are captured in live traps. The animal is stretched and the neck is hyper-extended and dorsally twisted to separate the first cervical vertebrae from the skull. When done properly, the AVMA approves this technique as humane method of euthanasia. Cervical dislocation is a technique that may induce rapid unconsciousness and does not chemically contaminate tissue (AVMA 2013).

Shooting is a humane field method of euthanasia when conducted by experienced personnel. A gunshot is placed between the ears to damage brain tissue, resulting in instantaneous death. Shooting may be the quickest and only method available under most field conditions and should be performed discretely by properly trained personnel (AVMA 2013).

What Chemical Pesticide Methods are Available to WS-Utah

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 (**M-44):** M-44 can only be used by certified WS-Utah personnel, and therefore is only available during operational assistance. The use of M-44s for IPDM activities occur in rural settings on both private and public properties. Use of M-44s on private, public, or sovereign tribal lands in Utah must be agreed upon by the landowner or federal, state, or tribal land management agency. Currently, M-44's are only being used on private property.

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.

APHIS-WS personnel that use the M-44 must be certified by the UDAF since it is a restricted-use pesticide. WS-Utah personnel always follow the EPA's label of 26 use restrictions and WS Directives 2.401 and 2.415 (Section 2.4 A5, A6). Per the EPA registration label, M-44 devices may only be used for control of coyotes, red foxes, gray foxes, and wild dogs that are vectors of communicable diseases or suspected of preying on livestock, poultry, and/or federally-listed T&E species.

In response to petition from an environmental advocacy organization, the EPA completed a review of complaints concerning risks to non-target species (including T&E species), environmental contamination, and human health and safety risks regarding use of sodium cyanide (EPA 2009). Based on the review and updated use restrictions, the EPA determined that use of M-44s are in accordance with label requirements. EPA determined that the revised APHIS-WS pesticide accounting and storage practices do not pose unreasonable risks to the environment.

Livestock Protection Collar (LPC): The LPC containing the chemical sodium fluoroacetate (Compound 1080) is registered with the EPA (EPA Reg. No. 56228-22) for APHIS-WS use nationwide. Before use in individual states, the registrant must receive approval from the State agency that oversees pesticide usage. The LPC is incorporated into the current IWDM program. WS-Utah use of the LPC follows EPA registration and UDAF requirements, and is restricted to specially trained and certified WS-Utah employees.

Sodium fluoroacetate has been used since World War II, and has been the subject of wide research in the United States and elsewhere and has been widely used for pest management programs in many countries. Fluoroacetic acid and related chemicals occur naturally in plants in many parts of the world and are not readily absorbed through intact skin (Atzert 1971). Sodium fluoroacetate is discriminatingly toxic to predators, being many times more lethal to them than to most nontarget species (Atzert 1971, Connolly and Burns 1990). Sodium fluoroacetate is a white powder soluble in water and is very stable in solution; it would only be used in the LPC. Sodium fluoroacetate kills by disrupting the Kreb's Cycle, which is the energy producing process for cells. Many EPA imposed restrictions apply to the use LPCs (EPA Reg. No. 56228-22).

The LPC is constructed to fit two different size lambs. An individual collar contains 1.1 oz. (30.4 grams) of a 1% solution of sodium fluoroacetate and 99% inert ingredients. The LPC is worn around the neck of lambs and kills only the animal attacking collared lambs (Connolly et al. 1978, Johnson 1984, Burns et al. 1988). When LPCs are used, lambs are made susceptible to attack to prompt target predators to attack collared lambs (Blakesley and McGrew 1984, Scrivner and Wade 1986, Connolly and Burns 1990). LPCs consist of two bladders that are punctured when a collared lamb is attacked and bitten on the throat by a predator. Upon puncturing the collar, the offending animal ingests some of the solution and dies. In this usage, sodium fluoroacetate has virtually no risk of secondary poisoning In FY10 through FY14, 4 LPCs were punctured to resolve depredation incidents annually (MIS 2010, 2011, 2012, 2013 and 2014). In FY15, no LPCs were punctured (MIS 2016).

Literature Cited

American Veterinary Medical Association (AVMA). 2013. AVMA Guidelines for the Euthanasia of Animals: 2013 Edition. https://www.avma.org/KB/Policies/Documents/euthanasia.pdf

EPA 2009. M-44 label

Fowler and Miller 1999.

Schering-Plough Animal Health 1999.

WS 2009. Aviation Safety Rules

Appendix F: Federal Laws and Executive Orders Relevant to WS-Utah Actions

Federal Laws

For relevant state laws, see Section 1.8 of this EA.

National Environmental Policy Act (NEPA)

Most federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). When APHIS-WS enters into an agreement to assist another federal agency to manage wildlife damage hazards, the other federal agency must also comply with NEPA. APHIS-WS policy is to work together for compliance. NEPA requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes. The two primary objectives of the NEPA are: 1) agencies must have available and fully consider detailed information regarding environmental effects of federal actions and 2) agencies must make information regarding environmental effects available to interested persons and agencies before decisions are made and before actions are taken.

APHIS-WS complies with CEQ regulations implementing the NEPA (40 CFR 1500 - 1508) along with USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Pursuant to the NEPA and CEQ regulations, WS NEPA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions. NEPA documents are prepared by integrating as many of the natural and social sciences as relevant to the decisions, based on the potential effects of the proposed actions. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

Pursuant to the NEPA and CEQ regulations, WS NEPA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions.

Endangered Species Act

Under the ESA (16 United States Code (U.S.C.) 1531 et seq., Endangered Species Act (ESA) of 1973, as amended; 16 U.S.C. 703-712), all federal agencies will seek to conserve threatened and endangered species and will utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). WS conducts Section 7 consultations with the United States Fish and Wildlife Service (USFWS) to use the expertise of the

USFWS to ensure that "any action authorized, funded or carried out by such an agency…is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency will use the best scientific and commercial data available" (Sec.7 (a)(2)). Depending on the species, the US Fish and Wildlife Service (USFWS) and the NOAA National Marine Fisheries Service (NMFS) are charged with implementation and enforcement of the Endangered Species Act of 1973, as amended and with developing recovery plans for listed species. Under the authority of the ESA, the USFWS acts to prevent the extinction of plant and animal species. It does this by identifying species at risk of extinction, designating ("listing") these species as threatened or endangered, providing protection for these species and their habitats, developing and implementing recovery plans to improve their status, and ultimately "delisting" these species and returning full management authority to the states and tribes. While a species is listed, most management authority for the species rests with the USFWS/NMFS. However, the agencies continue to work with other Federal agencies, states, and tribes along with private landowners to protect and recover the species. The USFWS helps ensure protection of listed species through consultations (section 7 of the ESA) with other Federal agencies. Under section 10 of the ESA, the USFWS also issues permits which provide exceptions to the prohibitions established by other parts of the Act. These permits provide for conducting various activities including scientific research, enhancement of propagation or survival, and incidental take while minimizing potential harm to the species. For species federally classified as threatened, the USFWS may also issue 4(d) rules which may allow for greater management flexibility for the species. The USFWS also issues grants for protection and enhancement of habitat and for research intended to improve the status of a listed species.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Amendments

FIFRA is the primary act under which the registration of pesticides is regulated. FIFRA authorizes Federal agencies to regulate the distribution, sale, and use of pesticides to protect human health and the environment. FIFRA authorizes EPA to review and register pesticides for specified uses. EPA also has the authority to suspend or cancel the registration of a pesticide if subsequent information shows that the continued use would pose unreasonable risks.

All pesticides distributed or sold in the United States must first be registered by EPA, and then within the individual State where it is being distributed, sold, or used. The EPA registration process requires that pesticides will be properly labeled and that, if used in accordance with the label, the pesticide should not cause unreasonable harm to humans or the environment. FIFRA does not fully preempt state, tribal, or local law, therefore each entity may also further regulate pesticide use.

National Historic Preservation Act (NHPA) of 1966, as amended

The NHPA and its implementing regulations (36 CFR 800) require federal agencies to initiate the section 106 process if an agency determines that the agency's actions are undertakings as defined in Sec. 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under section 106. The Advisory Council on Historic Preservation (ACHP) and each state's State Historic Preservation Officer (SHPO) or the tribal government Tribal Historic Preservation Officer THPO) have the primary non-regulatory jurisdiction. If an individual activity with the potential to affect historic resources is planned under an alternative selected as a result of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted with the SHPO or THPO as necessary.

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (Public Law 101-106, 25 USC 3001) requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal agencies are to discontinue work until the agency has made a reasonable effort to protect the items and notify the proper authority.

The Wilderness Act (Public Law 88-577(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 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 FWS. The Migratory Bird Treaty Act established a Federal prohibition, unless permitted by regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird. FWS released a final rule on November 1, 2013 identifying 1,026 birds on the List of Migratory Birds (FWS 2013). 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 (FWS 2013). 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, 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 could use those immobilizing and euthanasia drugs. Veterinary authorities in each state have the discretion under this law to establish withdrawal times (i.e., a period after a drug was administered that must lapse before an animal may be used for food) for specific drugs. Animals that people might consume within the withdrawal period must be identifiable (e.g., use of ear tags) and labeled with appropriate warnings.

Fish and Wildlife Act of 1956 (section 742j-1) - Airborne Hunting

The Airborne Hunting Act, passed in 1971 (Public Law 92-159), and amended in 1972 (Public Law 92-502) was added to the Fish and Wildlife Act of 1956 as a new section (16 USC 742j-l). The USFWS regulates the Airborne Hunting Act but has given implementation to the States. This act prohibits shooting or attempting to shoot, harassing, capturing or killing any bird, fish, or other animal from aircraft except for certain specified reasons. Under exception [see 16 USC 742j-l, (b)(1)], state and federal agencies are allowed to protect or aid in the protection of land, water, wildlife, livestock, domesticated animals, human life, or crops using aircraft.

Presidential Executive Orders

Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (Executive Order 12898)

Executive Order 12898 promotes the equitable treatment of people of all races, income levels, and cultures with respect to the development and implementation of federal actions, and enforcement of environmental laws, regulations and policies. Executive Order 12898 requires federal agencies to make environmental justice part of their mission, and to identify and address, when appropriate, disproportionately high and adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income persons or populations.

Protection of Children from Environmental Health and Safety Risks (Executive Order 13045)

Children may suffer disproportionately for many reasons from environmental health and safety risks, including the development of their physical and mental status. This executive order requires federal agencies to evaluate and consider during decision-making the adverse impacts that the federal actions may have on children.

Invasive Species (Executive Order 13112)

Executive Order 13112 establishes guidance for federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm or harm to human health. The Order states that each federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law: 1) reduce invasion of exotic species and the associated damages, 2) monitor invasive species populations and provide for restoration of native species and habitats, 3) conduct research on invasive species and develop technologies to prevent introduction, and 4) provide for environmentally sound control and promote public education of invasive species. This EO created the National Invasive Species Council (NISC).

Consultation and Coordination with Indian Tribal Governments (EO 13175)

This EO directs federal agencies to provide federally recognized tribes the opportunity for government-to-government consultation and coordination in policy development and program activities that may have direct and substantial effects on their tribe. Its purpose is to ensure that tribal perspectives on the social, cultural, economic, and ecological aspects of agriculture, as well as tribal food and natural-resource priorities and goals, are heard and fully considered in the decision-making processes of all parts of the Federal Government.

Facilitation of Hunting Heritage and Wildlife Conservation (Executive Order 13443)

This order directs Federal agencies that have activities that have a measurable effect on outdoor recreation and wildlife management, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat. It directs federal agencies to cooperate with states to conserve hunting opportunities. APHIS-WS cooperates with state wildlife and other resource management agencies in compliance with applicable state laws governing feral swine management. State, territorial, and tribal agencies, not APHIS, have the authority to determine which species are managed as a game species, hunted, eradicated, contained, or managed for local damages.

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

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

Appendix G: Summary of the Relevant Scientific Literature: Trophic Cascades

What is the Purpose of this Appendix

The study of ecological trophic cascades is relatively new and very complex, with potentially many highly interrelated factors and inherent complications to developing and implementing robust studies and ecological computer models. Statistical analyses must be carefully chosen and applied to develop strong correlations and reasonable interpretation of study results. Different ecosystems may have inherently higher productivity than others, resulting in different comparative study outcomes. Each study looks at a very small question related to very broad and complicated interrelated systems, and a particular study addressing a specific question cannot be expected to provide an answer that can be applied broadly.

Therefore, this appendix simply briefly summarizes the scientific literature relevant to the broader questions related to trophic cascades and related factors subsumed within that possible ecological relationship. It is not intended to be an impact analysis related to WS-Utah IPDM actions, but rather provides the context for the impact analysis in Chapter 4. This appendix focuses on peer-reviewed published scientific literature, but because certain unpublished or non-peer-reviewed documents are frequently raised by commenters, they are included for context.

What Foundational Ecological Topics Inform the Discussion on Trophic Cascades

How do Carnivores Contribute to Ecosystem Biodiversity

Large terrestrial mammalian carnivores, such as wolves, coyotes, and dingoes, have been historically seen as threats to human lives, property, and domestic livestock (Schwartz et al. 2003, Ray et al. 2005, Prugh et al. 2009, Estes et al. 2011). Large mammalian carnivores have high metabolic demands due to being warm-blooded, and they have a large body size with large surface to volume ratio. Therefore, they typically require large prey and expansive, connected, unfragmented habitats. These characteristics often bring them into conflict with humans, their property, and livestock, and compete for wildlife that are also regulated game species.

Large carnivores are vulnerable to many human-created conditions, including habitat loss, degradation, and fragmentation, invasive and exotic species, climate change, and hunting, as well as to widespread lethal control conducted in response to human intolerance, often resulting in population depletion, extirpations, and extinctions (Ripple et al. 2014). Hunting by humans does not duplicate or replace natural predation because it differs in intensity and timing, resulting in dissimilar effects on prey behavior, age, and sex (Ripple et al. 2014, Ray et al. 2005). However, where large carnivores were once seen as impediments to conservation goals, including for protection of endangered species, they are now increasingly considered as essential players in efforts to preserve ecosystem biodiversity through structuring ecosystem interactions and providing ecological services (Ray et al. 2005, Wallach et al. 2008).

How are Ecosystems Structured

Ecosystems are structured through the dynamic interactions of abiotic factors such as weather, soil productivity, climate change, and surface and subsurface hydrology, natural perturbations such as wildfire, and the variety, composition, and abundance of fauna and vegetation present. Those dynamics change in abundance, variety, and distribution as components of the ecosystems change.

Studies suggest that large carnivores may directly and/or indirectly affect the populations of certain species in terms of presence, abundance, reproductive success, activities, and function within the ecosystem. These effects may partially result from their predatory activities on smaller animals, including other carnivorous predators (such as foxes, coyotes, and cats), animals that eat only vegetation (herbivores, such as rabbits and deer), and animals that eat both vegetation and meat (omnivores, such as bears, badgers, and raccoons). These effects can also change the biomass, variety, and productivity of the vegetation that is eaten by herbivores and omnivores. These relationships based on consumption is called a **food web**, which recognizes the web-like interaction of a set of interrelated food chains, including species that share the same foods and carnivores that consume other carnivorous species.

Within these webs, animals with similar food habits create **trophic levels**, where energy is transferred and transformed as animals from one level feed on animals or plants from a lower level. If interactions occur from one trophic level of the web to a higher or lower trophic level, this is considered a **vertical relationship**. If the interaction occurs within the same trophic level, such as when a larger predator kills or feeds on a smaller predator or omnivore, it is considered a **horizontal relationship**. Therefore, the large carnivores are considered apex predators (in the vertical relationship), because they are not naturally preyed on by other animals, except by humans (Duffy et al. 2007).

Therefore, an **apex** or **top predator** is defined as a species that feeds at or near the top of the food web of their supporting ecosystem and that are relatively free from predation themselves once they reach adult size (Sergio et al. 2014). As animals in each trophic level need to use some of the energy obtained through consumption for maintenance, growth, activities, and reproduction, a much smaller amount of energy is transferred from a lower trophic level to a higher one. This generally results in a fewer number of animals within each higher trophic level. The top trophic level of a food web generally has fewer species and smaller population sizes than lower levels (and typically larger body sizes), resulting in the need to feed on larger prey with less energy expended in order to meet their energy requirements for survival. Top carnivores also tend to be more vulnerable to sustained adverse perturbations in their environment and persistent high mortality rates, and therefore more susceptible to extirpation and extinction.

What is the History of the Study of Ecosystem Functions and Roles of Apex Predators

The history of recognizing the ecological roles of apex predators as something other than vermin or pests is relatively new (Ray et al. 2005). The concept was popularly introduced by Charles Darwin's *Origin of Species* (1859) in his concept of mutualism (domestic cats controlling mice, that that would otherwise eat bee honeycombs, affecting plants and pollinators; Ripple et al.

2016) In more contemporary times, the concept of top predators was publicized primarily by Aldo Leopold in 1943. In the 1950s and 1960s, relatively simple studies were conducted on the dynamic interrelationships of predators and their prey, using uncomplicated models and limited field experiments. In the 1970s, simple modeling and empirical field studies began to test the capabilities of top predators to ecologically structure lower trophic levels, evaluate the relationships between predator and prey, confer stability to populations, and cause ecosystem shifts between alternative stable states (e.g., Ballard et al. 1977, Stenseth et al. 1977).

In the 1980s, modeling and field studies expanded in complexity to include predator-prey relationships, population dynamics, and adaptive social behavior in response to the risk of being predated, including how behavior changes affected foraging behavior and life history of prey and how these dynamics interrelate ecologically. Studies also began considering the potential for some predators to eat other predators, acknowledging a food web that interacts both vertically and horizontally, and the potential to cause trophic cascades. In the 1990s, these studies became increasingly complex, further investigating the roles of predation risk and anti-predator behavior adaptations, and how these affect the fitness of an individual animals, populations, and communities, potentially contributing to behavior-mediated trophic cascades (Sergio et al. 2014).

Presently, studies are branching into increased use of field and interdisciplinary research to investigate more realistic community, food web, population, ecological community, and individual animal responses to manipulations, and intended perturbations of communities of predators and prey, including direct and indirect behavior adaptations, ecological roles, predators killing other predators, and individual and species specializations of apex predators. Empirical field studies are increasingly using more sophisticated technologies to study wide ranging and secretive top predators, such as GPS satellite tags and collars (Sergio et al. 2014).

Originally, field studies were conducted on mostly sessile or low mobility species and webs, such as invertebrates, spiders, plankton, and small fish in localized ecosystems in relatively high productivity streams, lakes, intertidal zones, grasslands, and agricultural areas (e.g., Schmitz et al. 2004, Ray et al. 2005, Beschta and Ripple 2006). Expanding these studies to open ocean marine and terrestrial ecosystems with more wide-ranging predators and prey that are inherently more difficult to manipulate and create perturbations in, especially without causing moral, ethical, and political controversy, created extensive challenges in methodologies and complexity (e.g., Ray et al. 2005, Brashares et al. 2010, Estes et al. 2011, Sergio et al. 2014). Researchers also questioned whether the correlative results of studies that are small scale in time and/or space and conducted in ecologically relatively simple and localized ecosystems such as grasslands, agricultural fields, salt marshes, and marine intertidal zones could be extrapolated and applied to larger scale circumstances associated with trophic interactions in marine and terrestrial ecosystems across broad land and seascapes (e.g., Loreau et al. 2001, Srivasta and Vellend 2005).

It is extremely difficult to establish complex causal links between the indirect effects of top predators cascading over several trophic levels, and is still the subject of modern studies. Only recently have researchers conducted empirical studies of the roles of large carnivores in structuring communities, including the roles in ecosystem stability, biodiversity, and ecosystem functions (Ray et al. 2005).

What is a Trophic Cascade

In theory, apex predators may shape major shifts in the structure and function of ecosystems, as their predation and behavior ripple down and across food webs. These apparent ripple effects can create alternative and possibly long-term ecologically stable states that differ from the original state before the perturbation to apex predators, which ultimately becomes the persistent state (**homeostasis**). These changes may progress smoothly over time as the changes themselves occur, or, more likely, may occur when some threshold or "tipping point" is reached, at which point the structure and/or function shifts to different stable condition. During this phase shift, the conditions may rapidly fluctuate and species populations may rapidly increase then crash, before settling into the subsequent new and persistent condition.

Theoretically, the loss of one or more apex predators may result in shorter links within the food web because the apex predator is no longer present. This can potentially result in the release (in terms of numbers, distribution, biomass, etc.) of smaller predator and/or omnivore species that the apex predator preyed upon or behaviorally controlled. **Behavioral control** means that the prey exhibited adaptive anti-predator behavior that lowered its ability to forage optimally or kept individual animals in chronic physiological stress, resulting in lower overall fitness at the individual and community levels. In other words, the species' population was controlled by apex predators in such a way that the prey population could not reach the **carrying capacity**, or the maximum number of a species that the environment can support indefinitely (i.e., due to natural abundance of food and habitat resources). When the apex predator is at too low an abundance or density to create ecological restrictions on the prey population, or is no longer present, the controlled predator species may be released from the top-down control formerly exerted by the apex predator, and typically becomes the apex predator of the now-shifted system.

Theoretically, populations controlled by the new top predator may now release control on their prey, which may be herbivores, small mammals, or even vegetation. For a simple example, coyotes may now exert a greater predatory pressure on red foxes, decreasing their numbers, which may then release control on small rodents, resulting in increasing rodent populations. If this release is sufficiently high, the small rodent population may then increase dramatically, which may subsequently suppress the species composition or biomass of the vegetation eaten by the mice. This vertical control from top predators that may ripple through the food web is called **top-down control**.

The web is further complicated by a horizontal interaction within a food web, when one predator preys upon or otherwise controls another predator. This sideways feeding is called **intraguild predation** or **IGP**. A **guild** is made up of species that tend to play similar roles within a food web, such as carnivore, omnivore, or herbivore. See Section F.8.1 for more information on IGP.

When the population of the smaller predator (intraguild prey) is released by the extirpation, extinction, or severe control of the intraguild predator, that dynamic is called **mesopredator release**. A mesopredator species tends to be an intermediate predator within a food web, one that is typically smaller than the lost apex predator species, more of a generalist in terms of diet, and may be small enough to exploit more potential food niches. Mesopredator species often have a relatively high intrinsic rate of increase because of high reproductive rates and/or because they respond with higher reproductive rates when their populations are below carrying capacity (called a **density dependent response**) and the populations are released from suppression. Examples of mesopredators that may be released when wolves (as top carnivore) are severely suppressed or extirpated from an area could be coyotes, badgers, foxes, raccoons, and feral and free-ranging cats, depending on the composition of the ecological community. Generally, under these circumstances, the coyote population then fills the trophic role of apex predator, alternatively exerting control and releasing species, depending on whether the impact is direct or indirect on the particular trophic level. See Section F.8.2 for more information on mesopredator release.

It is also possible that predator species may be indirectly controlled by lack of prey or low vegetative productivity. For example, a multi-year drought may reduce the plant forage of rabbits, reducing both the rabbit population and its intrinsic reproductive rate. This, in turn (with a lag time), may suppress the physiological fitness and intrinsic reproductive rate of its primary predator, for example, a coyote. This is called **bottom-up control**. Coyotes may then begin to feed more on foxes (an IGP situation occurring within the relatively same trophic level), which were not affected by the drought, because the plants that the small rodents fed on (different from the plants that the rabbits fed on) were more resistant to the effects of drought. If the IGP by coyotes on foxes is sufficiently high, the fox population may again be suppressed, releasing the mouse populations. Complicating this concept is that both top-down and bottom-up controls may occur simultaneously for the same and different components within the same ecosystem (Borer et al. 2005, Ritchie and Johnson 2009). Such top-down and bottom-up effects can be complicated by **interference competition** (where dominant predators interfere in the ability of subordinate predators to obtain resources), site productivity, behavioral adaptation to avoiding the risk of predation and obtaining high quality resources, and intrinsic "noise" in the ecosystem due to natural variation (Elmhagen et al. 2010). In the above example, coyotes could switch from rabbits to other smaller rodents and insects (prey switching) that foxes prey on and compete with the foxes for the same prey base.

These apparent up and down (or lateral) alternating trophic interrelationships (when one population increases, it may cause a decrease in another (a direct effect) and increase in a species in the next lower trophic level (an indirect effect), which may indicate an interrelationship among trophic levels called a **statistical correlation** (Section F.6.1). However, such correlations do not indicate that one relationship is actually caused by the other. For example, large irruptions of mouse populations may be interpreted as being indirectly related to, for example, removal of a predator that feeds on mice, but may actually be caused by factors that were not considered, such as human food subsidies.

Polis et al. (2000) also recommend that researchers distinguish between potential cascading or rippling interactions at the species level (those occurring within a subset of the food web of a community, such that changes in predator numbers affect the success of one or more subsets of the plant species) and at the community level (those occurring where cascades considerably alter the distribution of plant biomass through the trophic levels of the entire system). This adds further complexity to empirical studies and interpreting results.

It is inherently extremely difficult, if not impossible in many circumstances, to develop and implement study protocols for field experiments resulting in statistically strong correlations. It is also inherently difficult to determine, even with replication of studies resulting in similar correlations, that inter- and intra-trophic relationships are caused by ecological perturbations, such as the removal of an apex predator, or that the removal results in a trophic cascade. Frequently, top-down effects do not appear as strong or to produce predicted cascading effects in terrestrial ecosystems due to the complexity of factors, such as the effects of dispersal and immigration, social regulation, and interference competition among predators, and abiotic factors, such as weather, soil, ecosystem productivity, and spatial and temporal habitat heterogeneity (Halah and Wise 2001, Ray et al. 2005, Berger et al. 2008, Estes et al. 2011).

Section F.13 details the inherent challenges of modeling and designing empirical field studies that determine statistically-correlated interrelationships between ecological factors. These studies may indicate needs for further investigation or potentially establish factors that can be shown to create a direct causation for the observed effect through study replications. Terrestrial ecosystems, food webs, and their processes are especially complex, with wide-ranging apex predators and intricate and adaptive predator and prey behaviors.

What is the History of the Concept of Trophic Cascades and its Definitions

Since the 1980s when Paine (1980) used the term "trophic cascade" to describe food webs in intertidal marine communities, trophic cascade has been a central or major theme of more than 2,000 scientific articles across many different ecosystems worldwide. Polis et al. (2000) and Ripple et al. (2016) expressed concern that, after decades of studies and modeling in many different ecosystems, the definitions and language used to describe trophic cascades have become inconsistent, obscuring and impeding both communication among researchers and the usefulness of the concepts for application in ecological management and conservation. To be useful and contribute to clarity, the definition must be both widely applicable yet sufficiently explicit to exclude extraneous interactions.

Ripple et al. (2016) provide a summary of the various definitions provided by researchers between 1994 and 2006. Trophic cascades were thought to only occur from upper trophic levels to lower trophic levels (top-down), until Terbough (2006) suggested that cascades can ripple either up or down a food web, with alternating negative and positive effects at successive levels. The first indirect effects of predators on plankton in lakes were suggested in the 1960s (Brooks and Dodson 1965, Hrbacek et al. 1966). Subsequently, Estes and Palmisano (1974) described the role of sea otters in structuring nearshore communities of sea urchins and kelp, later modified to include orcas and sea lions, based on changes caused by humans (Estes et al. 1998), a frequently cited example in the literature to this day. The research on trophic cascades began to shift from being dominated by studies in freshwater systems and old field grasslands and croplands to being dominated by terrestrial and marine systems in the early 2000s.

Based on a recent meta-analysis of scientific literature, Ripple et al. (2016) suggest trophic cascades be defined as indirect species interactions that originate with predators and spread downward through food webs. According to the authors, this definition does not require that trophic cascades begin with apex predators, nor that trophic cascades end with plants. The authors suggest that bottom-up effects are not downward trophic cascades, but what they call **knock-on effects**, in which effects spin-off from the main top-down interactions. Whether or not bottom-up effects are incorporated into the definition of trophic cascades (as Terbough et al. 2001, Ripple et al. 2013, and Ripple et al. 2015 suggest), research has indicated that effects may flow both directions at different times in dynamic ecological systems in which top and mesopredators are present and active. Such top-down and bottom-up effects can be complicated by **interference competition** (as mentioned in the coyote example above).

What is the Difference between Correlation and Causation in Interpreting Statistical Study Results

Before evaluating the scientific literature, it is important to explicitly define the difference between correlation and causation in order to better understand the statistical results of these studies. These terms are often misunderstood and misused when interpreting scientific papers. This discussion on correlation and causation is adapted from the Australian Bureau of Statistics (ABS 2013).

Correlation

A **correlation** is a statistical measure (expressed as a number) that describes the size and direction of a relationship between two or more variables. A correlation is suggested by a positive or negative relationship – when one factor increases, another may also increase (**positive correlation**) or decrease (**negative**, or **inverse**, **correlation**). If an apparent correlation is observed statistically, it does not mean that one factor causes the other, only that the one factor either goes up or down in relation to the other factor.

The strength of the apparent correlation, or the indication that there truly is some level of interrelationship, is determined using statistical formulas that should meet assumptions pertinent to the context of the data and the system being studied. The formulae provide a figure, known as the square of the correlation coefficient, or R^2, which is always a number between 0 and 1. A value closer to 1 suggests that a stronger correlation exists, indicating that the relationship may warrant further investigation and study. However, it is possible to identify strong, but meaningless, correlations, and many other factors may introduce complexity into the relationships as well as confound the apparent results.

As an example of an apparent, but not necessarily actual, correlation, we can use the observance of the onset of cold weather in the winter and increasing numbers of colds. As the temperature decreases in December, it may appear that people get more colds, an apparent inverse correlation. That could be a correlation, and an R^2 value may actually indicate a strong correlation. However, the cold temperatures also tend to occur during the holiday season. The suggested correlation between decreasing temperatures and increasing rates of illness may actually be more closely related to depressed immune systems from eating more sugar and increased exposure to viruses from greater contact with people. Despite an apparent correlation, it is also possible that decreasing December temperatures themselves do not directly cause increased rates of illness, and therefore wearing warmer clothes will not necessarily decrease the number of colds or the risk that an individual person will catch one.

The suggested statistical correlation can be confounded by many variables that may or may not have been incorporated into the statistical analysis, potentially resulting in misleading results. In another well-known example, the R^2 for the number of highway fatalities in the US between 1996 and 2000 and the quantity of lemons imported from Mexico during the same period is $R^2=0.97$ – a very strong correlation – but it is extremely unlikely that one causes the other. Generally, scientists and researchers will reject factors that show a weak correlation, but completely irrelevant factors can produce a statistically high R^2 coefficient, potentially leading researchers in the wrong direction.

Causation

Causation indicates that one event is the result of the occurrence of the other event. Proving that a strong statistical correlation is directly responsible for an observed result requires more than a high R^2 value. Once a strong correlation is indicated, researchers experimentally need to test their hypotheses for causation to determine if indeed the factor(s) considered in the statistical analysis caused the result (cause-and-effect relationship), rather than just suggesting a relationship. They need to determine that the result is not just varying up or down statistically in unrelated or potentially indirect ways, or that the results may be confounded by untested or unmeasured factors. For strengthening a potentially causal relationship, the tests must be replicated by other researchers using the same methods, scale, and contexts to determine if the results are truly causative.

A powerful research protocol is one that holds all factors constant but one, and then tests for statistically significant changes that indicate a causative relationship. The variable factor can also be changed and the results tested to further clarify a causative relationship. A statistically significant finding is one that would occur more often than it would if it were to occur randomly.

Conclusion

When relying on studies, it is critical to understand that statistical correlations, which are offered by researchers as suggestive or indicative results often without replication, are different from conclusions of statistically significant causation. Ray et al. (2005) state that researchers are often influenced by numerous factors, including their education, cultural background, and inherent conditions of the ecological systems on which they work. Ecologists who specialize in some systems often favor certain hypotheses, interpretations, and factors measured, and discount others developed, to inform work on other systems.

Misinterpreting weak, or even strong, correlations or the results of theoretical models as indicative of causation is inappropriate and does not credibly represent the state of the science or the robustness of data and research protocols. More importantly, it can lead to uninformed decision-making and poor choices regarding conservation and management actions that may have unintended and damaging consequences. APHIS-WS reviews the pertinent literature and places priorities on studies that accurately account for correlations, have relevant assumptions, and disclose study and statistical limitations and strengths.

What do Relevant Studies Suggest about Trophic Cascades

The following studies are representative of empirical field research conducted on large predators in terrestrial ecosystems that are useful for understanding the complexities of trophic cascades and contributing processes:

- **Hebblewhite et al. (2005)**, in a study in Banff National Park (NP), suggested that human activity, including recreation, in one valley restricted the use of the area by wolves, while limited human activity in an adjacent valley allowed higher wolf use. Survival recruitment of female elk and recruitment of calves was higher in the valley with human activity and lower wolf numbers. Elk competed with beaver for willow in riparian areas could have important impacts on biodiversity and ecosystem function and structure. The authors suspected wolves were the primary correlating factor in the observed cascading effect, but recognized that other predators may be implicated to an unknown degree.
- **Ripple and Beschta (2006)** hypothesize that an increase in human recreation in Zion NP resulted in a catastrophic regime shift to lower cougar densities and higher mule deer densities, higher herbivory on cottonwood trees, lower recruitment of young trees, increased bank erosion, and reductions in both terrestrial and aquatic species abundance. A top-down trophic cascade model would predict an increase in producer biomass following predator removal, while a bottom-up model would predict little or no change in consumer or producer biomass. Additionally, other likely interaction pathways include increased species interactions, improved nutrient cycling, limited mesopredator populations, and food web support for scavengers. The canyon with low human activity showed high recruitment of cottonwoods, hydrophytic plants, wildlife, amphibians, lizards, and butterflies along the creek, as well as presence of small endemic fish, with fewer eroded banks and altered channel widths. The diminishment of cottonwood forests in the riparian area reflects a potentially strong trophic cascade with ultimate effects on the structure and ecology of stream floodways, with decreased biodiversity. Without an appreciation of the potential for abrupt regime shifts and resulting new and persistent ecological stasis, the authors hypothesize that studies involving the removal of top predators are likely to provide conflicting results regarding function and structure of perturbed systems.
- **Ripple and Beschta (2007)** reported evidence of reduced browsing and increased heights of young aspen, particularly at areas with high predation risk (riparian areas with downed logs) after wolves were reintroduced into Yellowstone NP. Young aspen in upland settings showed continued suppression, consistent with the combined effects of trophic cascades, mediated by adaptive behavior related to predator risk avoidance by elk and lower densities of elk, indicating a recovering ecosystem. Much of the aspen growth observed in riparian areas after the reintroduction of wolves appears due to reduced

browsing by elk at sites with poor escape terrain and reduced visibility, rather than climate change or site productivity. The patchy recovery of as evidenced by increases in aspen height in the uplands as compared to riparian areas is consistent with recently reported patchy release of willow in Yellowstone (Ripple and Beschta 2006). The authors suggest that elk may be avoiding browsing certain riparian areas as an anti-predator strategy. The authors recognized that the broad-scale application of the results of this study are limited by the lack of an experimental control (area with no wolves) since the entire area was recolonized by wolves and that the data most likely represent the beginning of aspen recovery and not aspen population responses across Yellowstone's northern range. Concurrent increases in bison populations in Yellowstone's northern range may also be affecting the status of aspen communities.

- **Berger et al. (2008)**, in an often-cited article, suggested that wolf predation on coyotes in the Greater Yellowstone Ecosystem released the heavy coyote predation on pronghorn antelope fawns, resulting in increased pronghorn survival. The pronghorn population studied had not recovered from heavy market hunting, and the study found that fawn survival was four times higher in areas used by wolves where wolves predated on coyotes than in areas not used by wolves. Observed differences in fawn survival in areas with wolves may be sufficient to reverse the currently declining pronghorn population.

- **Kauffman et al. (2010)** suggest that, contrary to Ripple and Beschta (2006, 2007), survivorship of young browsable aspen are not currently recovering in Yellowstone NP, even in the presence of a large wolf population. A marked reduction in elk followed wolf reintroduction at the same time that drought reduced forage availability and hunting by humans increased outside the park during and after winter elk migration, indicating that the difference in aspen recover may be based on factors other than response to predation. Contrary to findings of previous researchers, the authors suggest that much of the variation in aspen reproduction was not due to elk browsing levels in response to predation risk, but to site productivity. Patterns of aspen recruitment are consistent with the effects of a slow and steady increase in elk abundance following the end of market hunting in the late 1800s and wolf extirpation in the 1920s. The authors' interpretation suggests that landscape level differences in habitat more strongly determined where wolves killed elk. Also contrary to Ripple and Beschta (2007), these authors suggest that aspen growth differences were due to the confounding patterns associated with abiotic factors such soil moisture, mineral content or patterns of snow accumulations, which vary widely across the landscape. Aspen sucker survivorship was lower near wolf territory core areas, likely due to wolves maintaining territories in areas of high elk densities, limiting the cascading impacts of behavioral changes due to predation risk, which apparently occur only in response to the near imminent threat of wolf predation. The authors suggest that aspen recovery across the northern range of Yellowstone NP will occur only if wolves in combination with climate and other predators further reduce elk populations.

- **Brown and Conover (2011)** conducted a large-scale removal of coyotes on twelve large areas in Utah and Wyoming to study effects on pronghorn antelope and mule deer populations. Their data suggest that coyote removal conducted during the winter and spring provided greater benefit than removals conducted during the prior fall or summer for increasing pronghorn survival and abundance. Unlike that for pronghorn, the data suggest that coyote removal during any season does not affect mule deer populations.

- **Ripple and Beschta (2011)** repeat earlier aspen and cottonwood surveys and measure browsing heights to determine recovery of aspen in the northern range of Yellowstone NP. The authors suggest that browsing on the tallest aspen stems decreased from 100% in 1998 to averages of less than 25% in the uplands and less than 20% in the riparian areas by 2010, increasing aspen recruitment and growth. Synthesis of trophic cascade studies conducted in Yellowstone NP within 15 years after wolf reintroduction generally indicate that the reintroduction of wolves restored trophic cascade with woody browse species growing taller and canopy cover increasing in some areas. After wolf reintroduction, elk populations decreased and beaver and bison populations increased. Despite indications that wolf reintroduction created substantial initial effects on both plants and animals, northern Yellowstone NP appears to be in the early stages of ecosystem recovery and results may differ over time.

- **Ripple et al. (2011)** suggest that it is possible that disrupted trophic and competitive interactions among wolves, coyotes, lynx and snowshoe hares after wolf extirpation may be sufficient to chronically depress hare and lynx populations; human-caused habitat fragmentation and livestock presence may have added to the depressed populations in Banff NP. With wolf extirpation, coyotes predated on hares, competing with lynx. The authors hypothesize that warming climates may increase coyote predation on hares in areas with lower snowpack even at higher elevations typically used by lynx, because coyotes can better traverse areas with less deep snow.

- **Beschta and Ripple (2012)** report that, following extirpation of large predators (wolves, cougar, and grizzly bears) in Yellowstone, Olympic, and Zion National Parks in the early 1900s, large ungulate populations irrupted, with increased herbivory on riparian cottonwood, willow, and aspen communities. Beavers abandoned willow communities, resulting in loss of pond habitat and deepening of streams with bank erosion within twenty years. Nearly two-thirds of Neotropical migrant birds depend on riparian vegetation during the breeding season, even though riparian systems make up 1% to 2% of total land areas in the western US. As streambanks eroded, the level of coarse streambed sediments decrease with an influx of finer sediments during the erosion of floodplains which effectively fill in gravel interstices, changing benthic habitats in streams, increasing water temperature degrading fish habitats with losses of stable overhanging banks and ripple flows with low sediment loads. If apex predators are reintroduced, the effects may or may not be reversible, depending on whether the level of reduced herbivory can be sufficiently maintained.

- **Levi and Wilmers (2012)** analyzed 30 years of data involving intraguild predation involving wolves, coyotes, and foxes to determine any effect on trophic cascades found correlational interrelationships, based on a plausible mechanism of increased interference competition between closely-sized canids. Theory suggests that guild interactions with an even number of species will result in the smallest competitor being suppressed, while guild interactions with an odd number of species may result in the smaller predator being released (Levi and Wilmers 2012).

- **Squires et al. (2012)** question the interpretations of the data published by Ripple et al. (2011), finding the correlations between recovering wolf populations and benefits to lynx populations through reduced coyote populations and through reduced competition among ungulates and snowshoe hare have weak or contradictory empirical support in the available literature. The authors believe that these findings cast doubt on the usefulness of Ripple et al.'s (2011) hypotheses and demonstrate the importance of experimental and comparative documentation when proposing trophic cascades in complex food webs. The authors caution against "publishing unsupported opinions as hypotheses that concern complex trophic interactions is a potential disservice to lynx conservation through misallocated research, conservation funding, and misplaced public perception."

- **Callan et al. (2013)** suggest that deer in Wisconsin were more abundant at the peripheries of wolf territories, based on evidence of higher deer herbivory (deer feeding on plants) on the territory margins than in core wolf territories. Understory vegetation in white cedar stands may be more influenced by bottom-up hydrology and ecological edge effects than by trophic effects. Areas with high plant diversity may increase deer densities that then attract and maintain higher wolf densities. Addressing wolf impacts at the scale of wolf territory rather than at a regional scale (rather than studying results within particular wolf territory, studies are conducted on whether wolves are present in a larger area) could have implications for study results. Research is essential to determine the level of scale at which a pattern becomes detectable above the ambient noise of ecological variation for understanding relationships between patterns and process.

- **Marshall et al. (2013)** refute conclusions of previous researchers regarding willow recovery after wolf reintroduction. In Yellowstone NP, the authors found that moderating browsing by elk alone is not sufficient to restore willows in riparian areas along small streams – such recovery depends on eliminating browsing and restoring hydrological conditions that occurred before wolves were extirpated. Beavers were common in the park, and interacted symbiotically with ecologically healthy riparian systems by the ecosystem. The riparian system provided tall willows that the beavers used to provide food and build dams, which created the hydrological conditions for healthy and sustained willow communities. Loss of beavers in the 20th century amplified the direct effects of herbivory by elk, lowered water tables, and compressed bare moist soils needed for willow establishment. In the absence of beaver creating necessary hydrologic conditions, ten years of total protection from elk browsing was not sufficient to allow willows to grow greater than two meters tall (resilient to browsing). This study indicated clearly that bottom-up control of willow productivity due to beavers exceeded top-down control by herbivory.

- **Painter et al. (2015)** further and refute the conclusions of both Kauffman (2010) and Ripple and Beschta (2007). The authors suggest that increased wolf predation on elk after wolf reintroduction played a role in substantial decreases in elk populations, interacting with other influences such as increased predation by grizzly bears, competition for forage with expanding bison populations, and shifting patterns of human land use outside the park towards irrigated agriculture (which become more important during droughts), reduced livestock densities, and increased hunting on the elk winter ranges. Currently, a large proportion of elk now winter on irrigated fields outside the park, a strong shift in distribution. Even with the near elimination of winter elk hunting after 2005, lower wolf numbers after 2007, mild winters after 1999, a major wildfire in 1988, and the end of the regional drought in 2007, the trend of declining elk density inside the park continued through 2012. Increasing bison populations inside the park (growth of three times between 1998 and 2012), either expanded into vacated elk winter range or perhaps displaced elk. The authors argue that research conducted by Kauffman et al. (2010) and Ripple and Beschta (2007) used protocols that differed in both timing and design, potentially missing patchy aspen recovery or recovery that was in the initial stages. Where herbivory has been reduced, bottom-up factors such as site productivity may become more important drivers of young aspen and willow height. The authors conclude that changing elk dynamics and beginning aspen recovery are consistent with top-down control of large herbivores by large carnivores.

- **Ripple et al. (2015)** suggest that increases in wolf numbers after reintroduction into Yellowstone NP resulted in decreased elk populations and increases in berry-producing shrubs, including serviceberry. Increases in serviceberry may partially be due to the 1988 wildfires or other factors. With increases in berries, grizzly bears increased fruit consumption, possibly in associated with decreased whitebark pine nuts rather than the effects of trophic cascades. Evidence of a trophic cascade associated with increases in wolf populations, decreases in elk populations, and associated increases in berries, may have resulted in grizzly bears increasing consumption of berries. This may show both a top-down cascade from wolf-elk-berries, and a bottom-up response with increased berry production and grizzly bears switching to now-available berries during periods of low production of whitebark pine nuts.

- **Benson et al. (2017)** suggest that eastern coyotes have ascended to the role of apex predators since the extirpation of wolves in northeastern North America. Eastern coyote packs consumed less ungulate prey and more human-provided food than wolf packs, being more generalists. Eastern coyotes are effective deer predators and are larger than western coyote (eastern wolves are smaller than western wolves), but their dietary flexibility as generalists and low kill rates on moose suggest that they have not replaced the ecological role of wolves as apex carnivores in eastern North America.

What is the Relationship of Intraguild Predation (IGP) and Mesopredator Release (MPR) to the Potential Occurrence of Trophic Cascades

Intraguild Predation

Interference competition, also known as competitive exclusion (Polis et al. 1989, Arjo et al. 2002, Finke and Denno 2005), is a system in which species in a community use similar diets and/or space and one species interferes with the ability of the other to optimize the use of food and habitat. Individuals of one or both species attempt to avoid this competition by using different parts of the same habitat, using the habitat at different times, and/or shifting to different foods (**resource partitioning**).

The **competitive exclusion theory** implies that coexistence of closely-related competitive species depends on resource partitioning and the degree to which shared resources are limited (Arjo et al. 2002). This is especially important when one or more predators interfere with other predator(s), called **IGP**. Relative body size and degree of trophic specialization are the two most important factors influencing the frequency and direction of IGP (Polis et al. 1989). Inherent live history characteristics such as litter size, growth rates, social structure, and density dependent interactions may influence the strength and direction of IGP correlations. IGP interactions may be directed preferentially towards predators with the closest rate of competition, often with the larger predator being dominant over the smaller (Polis et al. 1989). A review of the IGP literature found that the effects of IGP vary across different ecosystems, with the strongest patterns of IGP in terrestrial invertebrate systems. However, it is difficult to compare across systems and literature because of differences among study scales, sample sizes, and sampling methods (Vance-Chalcraft et al. 2007).

Polis et al. (1989) identified the complexities of potential types of interactions and responses associated with IGP at the population level: intraguild predators may benefit from reduced competition, especially when local resources are limited; IGP may be sufficiently intense to control populations of intraguild prey populations; intraguild predators may paradoxically increase populations of intraguild prey if the prey has density dependent responses to decreased abundance and competition; and/or presence of the IG predator may increase competition for habitat refugia.

At the community level, interactions over ecological and evolutionary time strongly influence the abundance of species. These interactions may influence distribution, resource use, and body structure, as intraguild prey often use habitat differently than their intraguild predator in space and time to avoid the risk of predation. In these early papers, Polis et al. (1989) and Arim and Marquet (2004) suggest that IGP is ubiquitous through various ecosystems, is not due to chance (found by Arim and Marquet (2004) to be statistically significant), and is a powerful interaction central to the structure and functioning of many natural communities.

Many researchers agree that the effect of IGP on trophic systems is understudied (e.g., Palomares 1995, Litvaitis and Villafuerte 1996, Palomares et al. 1996, Finke and Denno 2005). IGP is more likely to occur in predator guilds with many predator species, which increases the chances of IGP interactions (the intra-guild predator competing for shared prey and predating on other predators) and the potential for dampening trophic cascades (Finke and Denno 2005, Daughterty et al. 2007). Based on a review of the literature on IGP theory and modeling, Holt and Huxel (2007) concluded that most models are oversimplifications of natural systems, including by not considering richer webs of interacting species across heterogeneous landscapes.

Wolves may control coyote populations through IGP and competition (Berger and Gese 2007 found a statistically significant correlation) in the Greater Yellowstone Ecosystem and Grand Teton NP. Survival rates of resident coyotes were higher than that of transient coyotes. Humans were responsible for 88% of all resident coyote deaths; predation caused 67% of all transient coyote deaths, with wolves causing 83% and cougars 17% of that predation. Despite IGP on coyotes by wolves, it is possible that coyotes may arrange their territories to overlap wolf activity areas, possibly in response to increased scavenging opportunities within wolf territories.

Mesopredator Release

Early studies related to the conservation effectiveness of removing large predators indicated that such removals may result in unintended increases of populations of smaller predators. The increase of smaller predator populations may have further impacts on the prey populations of those smaller predators. This concept is now referred to as **mesopredator release**.

Cote and Sutherland (1977), in an analysis of the literature, concluded that predator control is often the one factor, other than human exploitation, that can be directly managed (the others being climate, productivity, diseases and parasites, availability of territories, and accidents). Predator control may increase target populations of breeding birds, but not reliably, based on immigration and the availability of the area's carrying capacity to support more birds.

On closed systems associated with oceanic islands (systems with highly restricted opportunities for emigration and immigration) on which exotic predators such as feral cats or rats are introduced, removing the apex predator may result in irruptions of mesopredators (removing the cats eliminated the suppressive effects on rats), which may lead to extinction of the shared prey. Rats, being omnivores, may maintain high abundance and high levels of predation, even when bird populations are low (Courchamp et al. 1999, Bergstrom et al. 2009, Roemer et al. 2009). Release of mesopredators by removal of apex predators on insular islands may have many unintended consequences, including reducing nutrient subsidies from predation by small mammalian predators on large colonies of birds, altering vegetation communities; driving native species to extinction or extremely low abundance; filling niches that can no longer be filled by apex predators; and creating reservoirs of diseases carried by mesopredators (Roemer et al. 2009). Despite these problems, Russell et al. (2009) argue that removing apex predators from oceanic islands may outweigh the negative effects of MPR.

Large mammalian carnivores are particularly vulnerable to extirpation and extinction in fragmented habitat due to human development, which may result in MPR of smaller predators, which are more resilient to extirpation (Crooks and Soulé 1999, Roemer 2009). In an area highly fragmented due to residential development, the authors found positive statistical correlation between coyote abundance and mesopredator abundance, especially opossums and foxes, and negative correlation between bird diversity and grey foxes, domestic cats, opossums, and raccoons. Mesopredators avoided areas of high coyote presence both temporally and spatially. Because domestic cats are recreational hunters subsidized by their owners, approximately 35 cats (from a neighborhood of 100 homes) were present in bird habitat fragments containing a very small number of birds (Crooks and Soulé 1999).

Prugh et al. (2009) asserted that collapses in top predators caused by human influences are often associated with dramatic increases in the abundance of smaller mesopredators across many types of communities and ecosystems. The authors defined a **mesopredator** as a mid-ranking predator in a food web regardless of size or taxonomy. A mesopredator in one food web may be an apex predator in another, and may not directly fulfill the original apex predator's ecological role in the web. The occurrence of a MPR is often symptomatic of fundamental ecological imbalances due to human activities, such as habitat fragmentation, introduction of exotic species, and provision of human subsidies. Overabundant populations of mesopredators are difficult to control because the species are usually characterized by the potential for high densities, high reproductive rates and rates of recruitment, and high rates of dispersal. The authors also assert that it is difficult to root out alternative explanations for mesopredator overabundance, such as habitat changes, that often occur with or cause the loss of apex predators. Uncertainty regarding the causal mechanisms underlying mesopredator outbreaks muddies prescriptions for management.

In a commonly cited meta-analysis by Ritchie and Johnson (2009), the authors reported that more than 95% of the papers reviewed suggested evidence of MPR and/or suppression of mesopredator populations by apex predators. The only exceptions involved species with specialized defenses, such as skunks or those that use specialized structural niches, such as arboreal behavior. Apex predators can affect mesopredator abundance through killing (and sometimes eating) them; through forcing behavioral shifts in foraging or use of habitats in time and space; and through direct aggressive interactions. These changes can have effects on population growth, predation rates, fitness, and survival. Bottom-up effects of vegetation productivity and community composition and distribution can affect abundance of species at all trophic levels, including IGP, attenuating or exacerbating the nature, strength, and direction of interactions among species (Thompson and Gese 2007, Ritchie and Johnson 2009). Apex predators may be more effective in controlling mesopredators in productive ecosystems (Ritchie and Johnson 2009).

In another commonly cited meta-analysis, Brashares et al. (2010) found evidence that MPR is a common result of the loss of apex predators in many systems throughout the world. Many current apex predators in some systems are exotic or invasive species. Loss of apex predators may or may not result in MPR, depending on the context. Additionally, increased abundance of mesopredators may or may not cause prey populations to decline, with mesopredators gaining dominance in areas of low productivity and high habitat fragmentation, and apex predators having more resilience in areas with high productivity and low habitat fragmentation. If a high diversity of apex and mesopredators consume a wide variety of prey, the potential for MPR and trophic cascades is weakened. Challenges in detecting MPR is difficult because of short duration studies, inherent natural variation, complex interactions among trophic levels, and researchers often invoke MPR when the apex predator has already been extirpated.

Another recent meta-analysis conducted by Ripple et al. (2013) suggested that any MPR effects due to wolves could be dependent on the context, and may be influenced by bottom-up factors, such as the productivity of a system without wolves. Factors such as human-provided food subsidies, scavenging opportunities on livestock and large ungulates, and existence of alternative prey may confound results. The authors suggest that a link exists between wolf population declines and expansion in the ecological influence of coyotes. The strength of any trophic cascade created by wolf recolonization may be dependent on whether wolf populations may reach ecologically-effective densities (also suggested by Letnic et al. (2007)), the amount of unfragmented habitat available, levels of wolf harvests and removals, and presence of refugia and food subsidies available to coyotes.

In Australia, researchers have suggested that widespread and intensive control of dingoes using aerial distribution of 1080-poisoned baits has resulted in releases of mesopredators, especially introduced foxes and cats (Letnic et al. 2007, Wallach et al. 2008, Brook et al. 2012), although Allen et al. (2014) argues that other plausible explanations may exist. Letnic et al. (2007) suggested factors that may also limit the control of dingoes on foxes include the abundance of prey (particularly introduced rabbits), seasonal activity patterns, levels of site and vegetation productivity, predator control regimes used, human food subsidies, and reproductive rates. Importantly, the authors argue that it is possible that top predators can ecologically express control over mesopredator populations only when apex predator population densities reach a certain threshold (also suggested by Ripple et al. 2013), which is likely to be above that at which apex predators pose a threat to livestock of human safety. Lack of human tolerance to predators may not allow that ecological threshold of abundance to be reached.

Similarly, Newsome et al. (2017) found that top predators suppressed mesopredators in areas where top predator densities were highest (core area), supporting the notion that removal of top predators can cause MPR. At areas outside the top predators core area, mesopredators and top predators have been shown to coexist, indicating that MPR may not occur when top predators are removed in those areas since mesopredators already had a realized ecological role. However, there is uncertainty with their results, since mesopredators could coexist in the high density core of a top predator’s territory, but those individual animals are thought to be difficult to detect. The authors note that abiotic factors, such as human disturbance and agriculture, caused both top predators and mesopredators to be absent from the area, dampening the strength of top-down forces enough to create a bottom-up driven system.

Wallach et al. (2008) suggest that dingoes originally coexisted with two endangered species (a ground-nesting bird and a rock-wallaby), and extensive dingo baiting may be the unintended cause of Australia’s extinction crisis due to MPR of introduced foxes and cats. Intensively baited dingoes may have managed to preserve pack cohesiveness due to learned behavior in response to human persecution, including becoming difficult to sample and highly secretive in areas of human presence and where they were expected to be exterminated. After intensive baiting of dingoes, endangered species may either crash (which is improperly attributed to the baiting program) or exhibit an exponential increase followed by a crash after a lag period (mesopredator populations increase during the lag period before adversely affecting the population of the endangered species). Brook et al. (2012) found evidence that controlled dingo populations hunted less at dusk (dusk being their common hunting period concurrent with prey activity), and therefore feral cats hunted more at dusk with higher efficiency. Cats may also have the additional behavioral advantage of climbing trees both to access prey and avoid predation by dingoes. Dingo densities may actually increase for a time following intense baiting due to dispersal of young dingoes.

Allen et al. (2013) demonstrated that the removal of dingoes did not result in increased mesopredator abundance. Further, Allen et al. (2014) argues that three often-cited studies purporting to provide evidence of MPR in Australia are actually plagued by imprecise sampling of predator populations. Additionally, none of the studies provide reliable evidence of MPR because there was no verification of reduced dingo populations due to baiting. The authors assert that, despite broad patterns of MPR demonstrations in some contexts, MPR cannot be reliably separated from other equally plausible explanations for the suggested interrelationships among dingoes, foxes, and cats. Additional research by Allen et al. (2018) has indicated that bottom-up effects (habitat and food availability) have a greater influence on hopping-mice (prey item of mesopredators) than the abundance of dingoes.

What is the Relationship of Adaptive Behavior, Resource Partitioning, and Human Subsidies to the Potential for Terrestrial Trophic Cascades

Adaptive Behavior

Since the late 1990s, researchers have recognized that individuals and groups of herbivorous and/or carnivorous prey animals use behavior that may be evolutionary-based or learned as part of a social system to reduce the risk of predation. Other non-consumptive and abiotic factors such as snowpack, system productivity, rainfall, and climate change may also affect how predators and prey (including predators as prey, or IGP) interact (Peckarsky et al. 2008). Although top predators will kill smaller predators, other factors, including behavioral responses such as shifting territories, adapting anti-predator behavior, and resource partitioning, are the primary mechanisms by which dominant predators can limit smaller predator populations (Casanovas et al. 2012).

Berger-Tal et al. (2010) suggest that adaptive behavior by predators and prey should be integrated into models of conservation theory, and recognize the role that human behavior plays in impacting animal behavior, such as overharvesting, habitat fragmentation, disturbance, and the introduction of exotic species. The key animal behaviors affecting survival, reproduction, and recruitment are changes in movements and use of space, behaviors related to foraging and avoidance of predation, and social behaviors.

Gese (1999) reported that elk and bison act more aggressively toward the alpha pair of wolves than toward betas and juveniles. Female elk with young act more aggressively toward predators than males to determine the most effective level of anti-predator behavior with the least use of energy (Gese 1999), perhaps responding to behavioral clues emitted by the predators themselves (Peckarsky et al. 2008). The type of hunting style use by different terrestrial large predators, such as "coursing" versus "sit-and-wait" may cause different anti-predator responses by prey.

For example, it may be easier to respond with less energy to coursing predators, such as wolves and coyotes, because it is easier to know if they are present or absent from an area than an animal that may be hiding and waiting for prey to mistakenly enter their attack range (Schmitz et al. 2004, Ritchie and Johnson 2009). However, Orrock et al. (2010), working primarily with fish and invertebrates, suggested that predators may change prey movements and behavior by "remote threat," even when the predator is not present (the predator causing a threat has been called a "keystone intimidator" by Peckarsky et al. 2008).

It is difficult to interpret the rationale for certain wildlife behaviors. Creel and Winnie (2005) disagreed with Hebblewhite and Pletcher's (2002) interpretation of elk grouping behavior near and far from cover. The latter interpreted elk foraging in meadows as a means to avoid predator attacks emerging from cover, the former reinterpreted the same behavior as release from anti-predator behavior when the short-term risk of predation was low, providing an opportunity for foraging in the best habitats. Creel and Winnie (2005) suggested that elk can assess temporal variations in predation risk on a sufficiently fine scale to determine the daily comings and goings of wolves through the senses, patterns of predator presence, and/or distribution of prey carcasses.

Prey may change their behavior to avoid chronic predation, including by humans, by changing the timing of activity (temporal behavioral change during the day or night) or the how they use the available habitat spatially in relation to the activity of the larger predator (Kitchen et al. 2000, Wilson et al. 2010). For example, Kitchen et al. (2000) reported coyote populations being significantly more active during the time period when predators are not (for coyotes, more active during the night while their eyesight is more adapted for optimal hunting during the day or dawn). Social animals may also be forced into behavioral and associated physiological changes under heavy human predation. Wallach et al. (2009) asserted that heavy predator control against dingoes (wolf-like canid) in Australia through aerial 1080 baiting fractured the social structure of packs, leading to changes in age composition, group size, survival rates, hunting abilities, territory size and stability, and genetic identity and diversity. When heavily controlled, dingoes learned to survive in areas deep in reserves and, conversely, directly near humans, livestock and areas of heavy baiting, utilizing additional food sources and passing on the anti-predator/human behavior to offspring.

Free-ranging domestic dogs were found to control distribution and habitat use of a small wild deer in South America due to high potential for harassment and attacks and resulting high lethality of attacks. Recreational hunting by subsidized domestic predators can cause behavioral and habitat shifts, reduction in fitness, and populations declines (Silva-Rodríguez and Sieving 2012).

Other important behaviors affecting the role of species abundance and recovery within trophic systems is dispersal, immigration into and out of a system or population, and territoriality. In species with social structures, such as wolves, dingoes, and coyotes, dispersal by beta and juvenile individuals may be due to little interaction with other pack members, lack of breeding opportunities, restriction to food resources by higher ranking members, and increased social aggressions from more dominant pack members (Gese et al. 1996, Gese 1996). Territories are areas that are defended from emigration by individuals that are not pack members, usually by the dominant pair, to limit or exclude competition for mates, food, and space (Gese 1998). Berger and Gese (2007) suggested that differential effects of wolf competition with coyotes on transient coyote survival and dispersal are important mechanisms by which wolves reduce coyote densities.

A challenge to interpreting the role of adaptive behaviors and other non-consumptive traits such as habitat or temporal shifts that are acquired over evolutionary time is that, when evaluating statistical correlations, these factors may have the same sign as consumptive factors (factors related to trophic interrelationships), moving in the same direction, so they may be overlooked or masked. Conversely, adaptive behaviors may also potentially increase the magnitude of trophic cascades that would otherwise be mediated by consumption. Non-consumptive effects may also be easily interpreted as bottom-up effects, or be considered as an afterthought to explain observations inconsistent with consumption-based theory, further confounding interpretation of study results (Peckarsky et al. 2008).

Resource Partitioning

Partitioning of resources in time and space are key behavioral methods for coexisting and minimizing competition between predators and prey, including predators that kill and/or eat other predators (IGP). Polis et al. (1989) identified **interference competition** (also called **competitive exclusion**; Arjo et al. 2002, Finke and Denno 2005, Brook et al. 2012), in which taxa in a community use similar diets and/or space and one interferes with the ability of the other to optimize the use of such resources. For example, hungry consumers may have greater movement in search of food, encountering predators or prey more frequently. Behavioral adaptations to minimize the risk of prey encountering predators can involve switching the use of habitats by using them at a time when it is likely that the predator would not be present (Palomares et al. 1996, Finke and Denno 2005, Hunter and Caro 2008) or switching their diet to minimize competition (Schmitz et al. 2004, Thompson and Gese 2007, Elbroch et al. 2015).

Several authors have reported that coyotes may eat smaller prey compared to wolves (such as deer, rabbits, or rodents rather than elk), while at the same time obtaining food directly provided by wolves through scavenging on large carcasses that the wolf pack cannot completely consume, such as elk and moose (Paquet 1992, Wilmers et al. 2003). Prior to wolf reintroduction in Yellowstone NP, coyotes depended on small mammals and scavenging carcasses late in the winter season, when animals were naturally weakened and died (Gese 1996, Wilmers et al. 2003). However, after wolves are reintroduced or they recolonize an area after extirpation, carcasses are provided throughout the winter, making direct interaction with wolves at a carcass, despite increased aggression and the risk of being killed, more energetically efficient than hunting (Arjo et al. 2002, Atwood et al. 2006, Thomson and Gese 2007, Wilmers et al. 2003). Food subsidies provided by scavenging introduces complexity into food webs. In Rocky Mountain National Park, over 30 species of mammalian and avian scavengers use wolf kills (Wilmers et al. 2003).

After reintroduction of wolves into Yellowstone NP, competition between cougars and wolves suggested that cougars significantly increased the proportion of deer in their summer diet and decreased the proportion of elk. Both wolves and cougars predated on elk calves in the summer, but elk had shifted their winter range to irrigated fields outside the park, as well as institutionalized winter feeding subsidies. This resulted in elk populations no longer being limited by natural carrying capacity, so neither wolf nor elk were limited in the summer by elk calf availability (Elbroch et al. 2015).

Atwood et al. (2006) found that cougars and wolves ate the same prey (elk) but in different habitats. Female cougars select habitat based on opportunities for hunting more than male cougars do. Lendrum et al. (2014) suggest that competition with reintroduced wolves in Yellowstone NP caused cougars to select habitat removed from known wolf pack territories and with buffers to reduce the potential for interactions with wolves. Avoiding wolves may result in use of less optimal habitat, especially for female cougars, which may have implications for survival of dispersing juvenile cougars and overall cougar dynamics.

Swift and kit foxes, closely related foxes that are much smaller than coyotes, are often killed by coyotes in areas where their home ranges overlap (Kamler et al. 2003, Moehrenschlager et al. 2007, Kozlowski et al. 2008); however, fox populations having higher survival rates tended to use portions of the overlapping home ranges that had more heterogenity, especially areas providing burrow and den refugia that allow rapid escape from coyotes. Home range sizes decreased as the availability of burrows increased, as it did in areas with lower shrub densities in which predators can be readily viewed and escaped more quickly (Moehrenschlager et al. 2007, Kozlowski et al. 2008).

More than body size and behavior, especially in non-canid mammalian predators, may cause resource partitioning. Even when raccoon and coyote home ranges overlapped, researchers found little evidence of coyotes killing raccoons, and little evidence that raccoons avoided coyotes. Since raccoons are opportunistic omnivores, there is little potential for direct competition. Raccoons also climb trees, which may provide a structural habitat partitioning (Gehrt and Prange 2006). Skunks avoid direct predation by larger carnivores through distinctive coloration and toxic emissions (Hunter and Caro 2008, Ritchie and Johnson 2009).

Human influence on habitat use, especially habitat fragmentation, human activity, and human food subsidies, is an important consideration for how individuals and populations interact and thrive (Litvaitis and Villafuerte 1996, Palomares et al. 1996, Fedriani et al. 2000, Fischer et al. 2012).

Human Food Subsidies

A review of the literature by Newsome et al. (2015) found that 36 terrestrial species in 34 countries used food provided by humans, such as discarded food, livestock carcasses, crops, and landscaping. With such subsidies, predator abundance increased (no longer limited by resources), diets were altered to include human-provided food, survival increased, and social interactions shifted to either the benefit or disadvantage of the predator. Predators also changed their home ranges, activity, and movements. Subsidies can result in induced behavioral or population changes and may result in trophic cascades, causing predator populations to no longer cycle with prey cycles. Top predators used primarily livestock, mesopredators used livestock carcasses and waste food, cats continued to use live prey, and bears mostly used crops, waste foods, and carcasses. Prey also used human presence and activities as shields from predators in some cases.

Fedriani et al. (2000) found that areas in southern California with high and patchy human residential development provided sufficient human food subsidies through trash, landfills, livestock, and domestic fruit, as well as providing subsidized habitat for rabbits. The study also found that coyote densities were eight times higher than in more natural areas (also, Fischer et al. 2012). As predator size increases, human tolerance tends to decrease (Fischer et al. 2012).

In urban areas, coyotes tended to avoid urban and crop areas, using safer corridors between patches of forest areas used for cover during the day and hunting (Arim and Marquet 2004, Gehrt et al. 2009). Gehrt et al. (2009) found mostly "invisible" coyotes avoiding humans and human-provided food in core areas of downtown Chicago and at O'Hare International Airport (similar to Wallach et al. 2008, Wallach et al. 2009). Raccoons, however, heavily used dumpsters and trashcans at night in areas with high human activity during the day (Gehrt et al. 2009). Bino et al. (2010) found that foxes, when human food subsidies were rapidly removed, responded by increasing or shifting their home ranges or dispersing from the area, and that fox densities in the urban area decreased substantially within a year.

How Do Predator Population and Social Dynamics Affect Ecosystem Structure and Function

The territory of an animal has been defined as the area that an animal will defend against individuals of the same species (Mech 1970, in: Gese 1998). Since the Knowlton and Stoddart (1983) study (and further clarified by Gese 1998), it is clear that the territorial alpha pair is the basic unit of wolf and coyote populations. According to Gese (1998), the alpha pair is responsible for monitoring and defending the territory and its resources from other conspecific predators from adjacent packs through patrolling and scent marking. Pack size varies geographically, with wolf packs more commonly composed of more individuals than coyote groups. Ecologically, the socially intact and operating wolf pack, not individual animals or even the alpha pair, is the unit that appears to control the structure and function of the ecological system (Wallach et al. 2009).

Maintaining the structure of the pack is critical for ensuring that the pack has the needed resources through shared hunting strategies and scavenging, collaborative care of the alpha pair's young, and learned behavior of the young for hunting efficiency and wariness of novel changes in the territory. In coyotes, only the alpha pair breeds and only 10% of the young from a given pair need to survive and reproduce to replace the pair. The remaining 90% of the beta (subdominant) and transient animals either stay in the pack without reproducing, die, or disperse, and often die before establishment in a new territory (Knowlton et al. 1999). Therefore, in the absence of human hunting, territories and associated population densities tend to remain relatively stable over time.

Population control of socially complex species like wolves may have profound ecological impacts that remain largely invisible if only abundance is considered. Heavy predator control (in this case intensive aerial baiting of dingoes with 1080) can seriously fracture pack social structure, leading to changes in age composition, group size, survival rates, hunting abilities, territory size and stability, social behavior, genetic identify, and diversity. Controlled populations tend to have a higher proportion of young breeding pairs and litters due to loss of dominant adults in the pack structure controlling access to breeding. Packs may disperse after the loss of the breeding pair and territory boundaries may weaken or dissolve, creating transient individuals that are more vulnerable to predation. The pack may also shift to another area under heavy exploitation and breakup of territories. Learned and practiced coordinated hunting behaviors within packs may be lost due to loss of social structure and changes to social traditions. A symptom of pack disintegration may be a decreased ability to take down larger prey and predators may shift to smaller and or more vulnerable prey. Smaller packs may reduce success at scavenging in the winter due to competition from larger predators. Intensive human removals may teach remaining animals to be highly secretive (Wallach et al. 2009).

Studies suggest that coyote territories do not remain vacant for very long after members 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 within a few weeks, despite removal of breeding coyotes. Blejwas et al. (2002) noted that a replacement pair of coyotes occupied a territory in approximately 43 days following the removal of the alpha territorial pair. Williams et al. (2003) suggested that temporal genetic variation in coyote populations experiencing high predator removal indicated that localized removal did not negatively impact population size. Gese (2005) found that after heavy removal rates (populations reduced between 44% and 61% over two years) there was a younger age structure in packs and increased reproduction by yearlings, with pack size and density rebounding to pre-removal levels within eight months post-removal. The author attributed some of the response to immigration of animals from outside the territory and increased lagomorph prey availability that apparently increased mean litter size in both the removal and control areas. Young animals, which are low in the social structure and subjected to lower resource accessibility, and some betas with no potential for becoming breeding alpha members of the pack, generally disperse (Gese et al. 1996), which may also keep genetic diversity high as dispersing animals fill vacated openings within another pack.

While it is true that wolf removal can have a short-term disruptive impact on pack structure, that disruption does not appear to result in adverse impact on the overall wolf population (Nadeau et al. 2008, Nadeau et al. 2009, Mack et al. 2010). Pack resilience to mortality is inherent in wolf behavioral adaptation and reproductive capabilities (Brainerd et al. 2008). Based on mean pack size of eight, mean litter size of five, and 38% pups in packs, Boertje and Stephenson (1992) suggested 42% of juveniles and 36% of adults must be removed annually to achieve population stability. Researchers have indicated declines may occur with human-caused mortality at 40% or less of autumn wolf populations (Peterson et al. 1984, Ballard et al. 1997).

The data on wolf mortality rates suggest some wolf populations tend to compensate for losses and return to pre-removal levels rapidly, potentially within a year. Wolf populations have sustained human-caused mortality rates of 30% to 50% without experiencing declines in abundance (Fuller et al. 2003). In addition, Brainerd et al. (2008) found that 62% of packs in recovering populations retained territories despite breeder loss. Furthermore, pup survival was primarily dependent on size of pack and age of pup because multiple pack members feed pups despite loss of an alpha breeder. Pup survival in 84% of packs with breeder loss was similar or higher than packs without breeder loss (Mech and Boitani 2003).

Wolves and coyotes with strong social structures can be resilient in the face of moderate levels of exploitation, and can recover abundance relatively rapidly. However it is not known at what population densities these species can exert top-down control through the ecosystem. Many populations are simply too small to actually cause top-down trophic cascades (Ray et al. 2005, Letnic et al. 2007, Ripple et al. 2013).

What is the Relationship of Trophic Cascades to Ecological Biodiversity and Ecosystem Function

Humans are the top predator in all systems, but the roles humans play as predator in trophic cascades, biodiversity, and ecosystem function are rarely considered (Ray et al. 2005). Most predators cannot directly and intentionally change their habitats and condition to serve their own purposes; only humans can do that.

Humans are altering the composition, ecosystem structures, and impacted diversity of biological communities through a variety of activities, such as logging, agriculture, grazing, development, climate change, loss of native species and additions of exotic or invasive species, with new functions that increase the rates of species invasions and extinctions, at all scales. Many human-altered ecosystems are difficult and expensive to recover, or may be impossible to reverse (Hooper et al. 2005, Ritchie et al. 2012). Biodiversity is declining a thousand times faster now than at rates found in the fossil record, and is becoming increasingly confined to formally protected areas, which may fail to function as intended due to size and lack of connectivity to other protected areas (Balvanera et al. 2006, Estes et al. 2011). Concern is growing that the loss of ecosystem services provided by biodiversity are adversely impacting human well-being (Hooper 2005, Balvanera et al. 2006, Cleland 2011).

Despite compelling experimental evidence, the relationship of biodiversity to ecosystem functioning and provision of ecological services has great uncertainty and is still contentious among researchers because the differences in experimental design, the results obtained, and interpretations of those results have not been consistent or universally accepted among the research community (Balvanera et al. 2006, Hooper et al. 2005).

Biodiversity can be described at many scales, from genetic to global (Hooper et al. 2005, Cleland 2011). Biodiversity can be measured in many ways as well, including **species richness** (the number of species in a system), richness of functional groups (the number of ecological functions performed by groups of species in a system), **evenness** (the distribution of species or functional groups across the system), species composition (the identity of species occurring in the system), and diversity indices (comparative measures, using whatever factors are measured). Typically, biodiversity is measured in terms of species richness, because it can be readily measured and compared, but that measurement ignores the complex interactions among species, population, communities, and abiotic factors (Ray et al. 2005, Balvanera et al. 2006, Cleland 2011).

The five top reasons for losses of biodiversity are human-caused habitat loss, fragmentation, and conversion; climate change; introduction of invasive and exotic species; pollution and nutrient enrichment (such as additions of farm fertilizers to aquatic systems); and overharvesting (Srivasta and Vellend 2005). However, these effects can be mediated to a degree by immigration and dispersal (France and Duffy 2006). The effects of biodiversity change in ecosystem processes are weaker at the ecosystem level than at the community level, and have a negative correlation at the population level (Balvanera et al. 2006).

Four mechanisms that account for biodiversity can influence the combined densities of predators and prey and their resources: sampling effects; resource partitioning; indirect effects caused by IGP, including diverse ecosystems with multi-trophic levels and multiple indirect effects; and non-additive effects resulting from consumers with non-linear complex functional responses (Ives et al. 2005).

Biodiversity can enhance the reliability and stability of ecosystem services and functions through more diverse communities and spatial heterogeneity (France and Duffy 2006). **Ecosystem stability** is defined as a system that changes little, even when disturbed; **ecological resilience** is defined as a system that, when perturbed, can recover to its original stasis (Cleland 2011). Ecosystems with low biodiversity have low resilience and are sensitive to disruptions, including perturbations caused by humans (Ritchie et al. 2012). Having a variety of species, including top predators, which responds differently to environmental perturbations can stabilize ecosystem processes (Hooper et al. 2005, Duffy et al. 2007).

Ecosystem functioning is a broad term that encompasses a variety of processes and reflects how the interrelated ecosystems involving biotic and abiotic factors work together. It depends on biodiversity and is the basis of the capability of the ecosystem to provide ecological services of value to humans (Hooper et al. 2005). Variation in ecosystem functions and processes can result from natural annual environmental fluctuations, directional correlational changes in conditions, and abiotic and biotic disturbances (Hooper et al. 2005).

Functional redundancy of species refers to the degree to which organisms do similar things within a system and that one species can potentially compensate for the loss of another (Hooper et al. 2005, Casula et al. 2006, Cleland 2011). A relevant example of lack of functional redundancy involves human hunting (with human as the top predator) and natural predation. Human hunting cannot replace the roles that top predators play because the timing and intensity of predation is different; different age and sex classes are targeted; hunting does not generally result in impacts to mesopredators; trapping can result in take of non-target animals; hunting requires infrastructure such as roads that have effects on animals and vegetation (such as mortality caused by collisions with vehicles). In many cases, human hunting and poaching are unsustainable in many parts of the world (Ray et al. 2005).

It is suspected that greater variations in response to changes in biodiversity occur than is reported in the literature, based on inherent complexities associated with variations in prey use patterns, prey use rates by predators, predator abundance, and predator-prey distributions and interactions. This complexity results in many plausible theoretical explanations for results obtained by modeling biodiversity (Casula et al. 2006), none of which are certain. Studies incorporating multi-trophic levels that more realistically reflect nature and that consider interrelationships are still rare in this discipline (Hooper et al. 2005).

Ecosystem services are the conditions and processes through which natural ecosystems and the species that comprise them sustain and fulfill human life, including purification of air and water, support of soil fertility, decomposing waste, climate regulation, pollination, regulation of pests and human diseases, creating conditions of aesthetic beauty, and maintenance of biodiversity (Srivasta and Vellend 2005, Balvanera et al. 2006). As human populations increase and human domination of the biosphere expands, managing ecosystems for human services will become increasingly important to prevent shortages of water, energy, and food, while attempting to decrease disease and war (Kremen 2005).

Substantial theoretical and empirical evidence exists that biodiversity is able to effect ecosystem function for plant communities, but it is not clear if these patterns hold for conditions involving large predator extinctions, multi-trophic communities, or larger spatial scales (Loreau et al. 2001, Ray et al. 2005, Srivasta and Vellend 2005). The major challenge is to determine how the dynamics of biodiversity, ecosystem function, and abiotic factors interact, especially with steadily increasing human-caused ecosystem degradations. Considering factors other than species abundance and richness (the number of species occurring in an ecosystem and the number of animals in each species), a more predictive science might be achieved if researchers developed an appropriate classification of ecosystem function integrating changes in biodiversity, ecosystem function, and abiotic factors into a single, unified theory that can be empirically tested (Loreau et al. 2001). This is extremely difficult to develop.

Understanding how biodiversity affects ecosystem function requires integrating diversity within trophic levels horizontally and across trophic levels vertically. Multi-trophic interactions may produce a richer variety of diversity and functioning relationships, depending on the degree of dietary generalization and specialization, trade-offs between competitive ability and resistance to predation, IGP, and immigration/dispersal. Little is known about how reducing the number of trophic levels or species or removing predator species affects ecosystem processes. Integrating more mobile large carnivores into research is an especially difficult challenge empirically (Duffy et al. 2007).

Experiments are often conducted at small scales with insufficient duration to account for turnover of the components in order to provide evidence for true change (as opposed to inherent natural variation), and biodiversity often includes exotic and invasive species. The effects of biodiversity on ecosystem function depend on the system being studied and the functions that are sampled and measured. Few studies have been conducted considering interactive effects of extinctions between two trophic levels, and those studies have mixed results (Srivasta and Velland 2005).

Srivasta and Vellend (2005) conclude that biodiversity is declining at global scales, but the scales at which empirical studies are being conducted are not scaled up to appropriate levels to reflect nature. The results of studies are inconsistent on whether biodiversity has positive effects on ecosystem function, especially because it is not known how these studies are being scaled up; ecosystem effects of extinctions in multi-trophic food webs are difficult to predict because of numerous and complex indirect effects and the likelihood of simultaneous or cascading extinctions through the trophic levels; and human-caused drivers of extinction effect ecosystem function to a large magnitude directly and indirectly.

Decreases in biodiversity often lead to reductions in ecosystem functions, then in the resultant ecosystem services. Declines in providing services are initially slow, but become more rapid as species from higher trophic levels are lost at faster rates. Different ecosystem services respond differently to losses of habitat and biodiversity, introductions of exotic or invasive species, and the variety of interactions among species within and between trophic levels. Because different ecosystem services tend to be performed by species at different trophic levels, and trophic webs tend to first thin before collapsing from top to bottom, the processes should be predictable and foreseeable. The best way to address biodiversity and ecosystem function is to ensure that the ecosystems remain viable for species with larger area requirements that tend to have less readily identifiable economic value, such as large carnivores (Dobson et al. 2006).

Sustainable and healthy populations of large predators have the potential to restore ecosystem stability and confer resiliency against global processes, including climate change and biological invasions (Duffy et al. 2007). Because the roles of predators are dependent on their context, the emphasis of research must be more focused on predator functions in ecosystems, including the importance of social structures and adaptive behaviors in influencing the dynamics of trophic interactions, and less on the identities and abundance of species. There is great variability and uncertainty surrounding the ecological functions of predators, including unpredictable and even counter-intuitive outcomes that may be caused by species interactions such as IGP and mesopredator release (Ritchie et al. 2012). However, it is inappropriate to assume that the mere presence of large carnivores ensures persistence of biodiversity (Ray et al. 2005).

The first species that tends to be lost or rendered ecologically extinct in both terrestrial and marine systems is almost invariably the large carnivorous predator, primarily due to their intrinsic rarity at the top of the trophic web, small population sizes, restricted geographic ranges, generally slow population growth rates, and specialized ecological habits. Top predators are especially vulnerable to human-caused habitat destruction and fragmentation, as well as exploitation and persecution due to conflicts with humans (Duffy 2003). Humans, as the top predator, have eliminated the largest predators from over 90% of the Earth, globally extinguishing ecological functions (Pace 1999, Ray et al. 2005).

Evidence suggests that the loss of one or more large carnivorous predator species often has impacts comparable in magnitude to impacts associated with a large reduction in plant diversity. This results in large changes in community organization, ecosystem properties and system functions (Duffy 2003). Apex predators tend to be the determinants of biodiversity structure and function, and the most challenging to conserve (Ray et al. 2005). Studying the results of the impacts of the loss of large carnivores on the structure and function of ecosystems is extremely difficult because of a complexity in trophic interactions. Evidence from ecological studies indicate that the largest contribution of changes in biodiversity on ecosystem function occurs when humans introduce exotic or invasive plant and/or animal species, which may increase the number of species in a system (species richness), while reducing ecosystem functions. Biodiversity will continue to erode under human influence (Duffy 2003).

Despite increasing research on the tangled complexity of food webs and trophic interactions, we have no better understanding of how to apply the results to conserving biodiversity and ecosystem function. Marine ecosystem cascades are generally caused by overexploitation of species eaten by humans; in terrestrial ecosystems, changes in biodiversity are generally caused by human-caused habitat destruction, fragmentation, and conversion. Large carnivores are generally not specialized in function or diet, so pristine conditions are not needed for survival; large carnivores are mostly resilient in the face of human perturbations, provided they have their basic baseline conditions. The primary problem with restoring large carnivores is competition with humans for space, resources, and property such as livestock (Ray et al. 2005), which can often lead to legal and illegal removals, concerns with human health and safety, and further pressures on endangered species (Ritchie et al. 2012).

Biodiversity, broadly defined, and the roles of large predators potentially contributing to biodiversity, clearly has strong effects on ecosystem functioning and provision of ecosystem services, which must be communicated to those charged with economic and policy decision-making to avoid ineffective and costly management actions (Hooper et al. 2005).

However, researchers have identified the need for consideration of ecological complexities in study designs for better determining true levels of biodiversity and their roles within ecosystems, including factors such as resource partitioning, indirect and additive effects (including IGP and MPR), multiple effects, social stability of packs of socially complex top predators, and multi-trophic systems. Studies must also be upscaled to more realistically represent larger systems, the results of which may then overturn the more general findings of the current studies of simplified systems (Ives et al. 2005, Srivasta and Vellend 2005, Wallach et al. 2009). More studies are also needed on the sequence of system collapse and replacement of ecosystem services as systems are further degraded (Dobson et al. 2006). The ecological roles of predators in supporting ecosystem biodiversity and functions and providing ecosystem services to humans are substantially unknown.

What Should Be the Role of Top Predators in Conservation Plans

Predator management is characterized by complex ecological, economic, and social tradeoffs that are often not readily apparent or mutually exclusive, as well as being very expensive. Large carnivore conservation is impeded because much of the habitat is already destroyed or has uses that conflict with predators, they can be perceived to be threatening to human safety, and they kill game species and livestock (Prugh et al. 2009, McShane et al. 2011, Ritchie et al. 2012). Replicating the full suite of influences provided by apex predators is exceptionally challenging if not impossible.

The ability to better predict mesopredator responses to reintroduction or gradual recolonization of apex predators would enhance effectiveness of management efforts. The daunting task of conservation of top predators requires substantial habitat restoration, greater public acceptance of large carnivores, and compromises among people most directly affected by these predators (Prugh et al. 2009). Also, little is known about the impact of trophic interactions, particularly predator-prey and predator-predator interactions on the relationship of biodiversity and ecosystem functioning in natural systems. Increasing predator diversity could promote trophic cascades if predator species act additively or hide trophic cascades if IGP is likely to occur in diverse predator assemblages (Finke and Denno 2005).

Because top predators need lots of room, have symbolic value, and can structure ecosystems under certain circumstances, they have the potential to gain public support for conservation programs to achieve higher scale conservation goals to restore degraded ecosystems. Large scale conservation should not be confused with the ecological roles and importance of apex predators to conservation. In areas where top predators were extirpated but the system was protected, such as in national parks, top predators may be effective in improving biodiversity and ecosystem function.

In areas with high levels of human-caused habitat change, development, and relatively unlimited prey (large populations of deer), gradual recolonization by top predators, such as by wolves in the northern Midwestern US, often increase the potential for conflicts with humans. The ability of top predators to reach a threshold density to play an ecological role for conservation may be limited by population reductions in response to human conflicts, including in areas surrounding reserves. The conservation goal must focus on reaching population levels and distribution of top predators that the threshold for creating ecological structure is reached and sustained (Ray et al. 2005, Letnic 2007, Ripple et al. 2013).

The best chances for using top predators for conservation purposes is where the extirpation of predators has been clearly shown to result in adverse ecosystem impacts and where the system has not been degraded by other factors. In terrestrial systems, where habitat conversion has created so many changes to biodiversity, the return of top predators may require long periods of time to reach conservation objectives, if recovery can be achieved at all (Ray et al. 2005).

The precautionary principle when designing conservation plans is important, shifting the burden of proof to those who discount the ecological role of predation, because thresholds of change may result in large and sudden phase shifts that may be impossible to reverse (Ray et al. 2005, Estes et al. 2011).

The most important questions regarding conservation of large predators, biodiversity, and ecosystem function remain unanswered:

1. In what locations and under what conditions to large carnivores play an ecologically significant role?

2. In what locations and under what conditions would restoration of large carnivores result in restoration of biodiversity?

3. What densities of large carnivores are necessary to produce the desired restoration of biodiversity?

4. What are the interactions between hunting by carnivores and hunting by humans? (Ray et al. 2005).

What are the Challenges Associated with Interpreting and Applying the Results from Studies Conducted in Different Ecosystems

Regardless of the context, Litvaitis and Villafuerte (1996) warn researchers not to confuse declines in apex predators and changes in lower trophic level species abundance as a cause-and-effect relationship, as both are likely a response to human activity, including collisions with vehicles, legal and illegal take, habitat fragmentation, development, and/or human subsidies. Interpretations of results must look for factors beyond those naturally occurring in the study area.

A primary challenge to testing the presence and strength of a trophic cascade involves removing predators from systems in which they are abundant or adding them to systems where they are absent, creating an intended perturbation that can be tested statistically (Estes et al. 2011, Ripple et al. 2016). With large free-ranging carnivores, intended removal of predators as part of a study is typically socially, ethically, and politically challenging or impossible (Ray et al. 2005, Estes et al. 2011). Therefore, many studies rely on areas in which large apex predators were extirpated and either reintroduced or rapidly recolonized the area, while the original conditions remain substantially the same, such as in older national parks, including Yellowstone National Park, Zion NP, and Banff NP (e.g., Heeblewhite et al. 2005, Ripple and Beschta 2006, Berger et al. 2008, Estes et al. 2011, Beschta and Ripple 2012, Ripple et al 2015).

Another challenge involved with conducting studies that provide statistically-strong results involves the temporal scale of the study, which must be of sufficient duration to incorporate the generation times of the component species, especially plants. While predator impacts have been observed over weeks and months in lakes, streams, and nearshore marine systems, decades or even centuries may be required for terrestrial systems where the base autotrophs may be shrubs or trees (Duffy 2003, Schmitz et al. 2004, Briggs and Borer 2005, Ripple et al. 2016, Engeman et al. 2017).

Relevant Publications Outlining Challenges

- **Ecosystems are more complex than first thought**: Pace (1999) suggested that cascades are more likely to be non-linear and food webs to be probabilistic due to highly variable conditions that promote and inhibit the transmission of the effects of predators on food webs (called trophic dynamics), including complicating and confounding factors such as differences in inherent primary productivity (the nutrition provided by the plant communities), adaptive predator-avoidance behavior, the potential for ecological compensation, and the availability of anti-predator refugia for prey. In other words, researchers began to understand that ecological interrelationships among biotic and abiotic components of ecosystems had blurred what had appeared to be clear boundaries and interconnections.

- **Top-down effects appear to dissipate faster on terrestrial ecosystems than in freshwater ecosystems:** Polis et al. (2000) suggest that this may be the result of aquatic systems better fitting the simplifying assumptions of trophic cascade models (such as incorporating discrete homogeneous environments and short regeneration periods for predators, and simple and trophically-stratified systems with strong and clearly identifiable interactions among species). They also suggest that most terrestrial systems are more complex and heterogeneous, with fuzzy boundaries between trophic levels, having variable prey and predator dynamics, and weak and diffuse interactions between species (except in human-designed agricultural systems). Species that have greater defenses against predation or herbivory tend to become dominant, weakening the link between predators and prey. The authors argue that, even at the species level, support for the presence of trophic cascades is limited in terrestrial systems (also, Halah and Wise 2001). Conclusions about the strength of top-down effects may be an artifact of the plant-response being measured, not a response that actually exists in the environment. Schmitz et al. (2004), based on a meta-analysis, reports that a conclusion that a cascading effect may be weak or non-existent or existent and strong may be an artifact of the was the species in a system are categorized and aggregated by the researcher (for example, whether a species is a mesopredator or an apex predator, or which predator species feeds on which prey species), and the conclusion may be dependent on the system topology as conceptualized for the specific web.

- **Certain ecological dynamics that occur in terrestrial ecosystems may not occur in aquatic ecosystems:** The additions of the concepts of IGP (Section F.8.1) and mesopredator release (MPR; Section F.8.2), in addition to non-consumptive factors such as adaptive anti-predator behavior and beneficial foraging behavior (Section F.9) in the face of differing predation risk based on the type of predator hunting behavior ("coursing" compared to "sit-and-wait"), further complicate the concept of trophic cascades in heterogeneric terrestrial ecosystems with socially complex and wide-ranging predators and prey (Ripple et al. 2016).

- **Some effects, though appearing in both ecosystems, may be weaker in terrestrial ecosystems:** A meta-analysis of research papers conducted by Halah and Wise (2001) related to terrestrial arthropod-dominated food webs found extensive support for the presence of trophic cascades in terrestrial communities, but that the effects on biomass of primary producers are weaker in terrestrial communities than in aquatic food webs. A meta-analysis of 102 scientific publications across different types of ecosystems (lakes/ponds, marine, stream, lentic and marine plankton, and terrestrial agricultural and old fields) conducted by Shurin et al. (2002) reported high variability among ecological systems, and that predator effects were apparently strongest in benthic communities in lakes, ponds and marine ecosystems, and weakest in marine plankton and terrestrial food webs (also Borer et al. 2005). The complexity of terrestrial food webs within which large wide-ranging and adaptable carnivores are at the top of the web may further weaken the statistically observable presence of predator-driven effects (Halah and Wise 2001).

- **Tradeoff behavior may be specific to the type of ecosystem and may contribute to the variability in the nature and strength of cascading effects:** Schmitz et al. (2004) conducted a meta-analysis of 41 studies conducted in aquatic and terrestrial ecosystems that indicated that one mechanism addressing the uncertainty about the ultimate mechanisms driving trophic cascades may be the trade-off behavior associated with prey avoiding the risk of predation while also attempting to forage optimally. Knowing the habitat and resource use by prey with regard to the presence of one or more predators, and the hunting mode of the predator ("coursing/patrolling" compared to "sit-and-wait") may help explain the considerable variability on the nature and strength of cascading effects among systems. Different hunting modes force prey to balance the energetic effects of reacting through vigilance, ceasing foraging and moving away, or exhibiting aggression. Prey responding to active, coursing predators may be the least risk averse, determining that foraging is more important than maintaining constant vigilance, especially later in the winter, when fitness is inherently reduced. Different predators apply different rules of engagement based on hunting mode and habitat use, which then drive adaptive behavioral responses and associated trophic effects (Schmitz et al. 2004, Peckarsky et al. 2008).
- **Studies may study small subsets of communities for short periods of time, making interpreting results difficult.** Borer et al. (2005) conducted a meta-analysis of 114 studies in terrestrial agricultural and grassland/shrub ecosystems mainly involving arthropods, lake, marine, and stream benthic communities. Of all the studies reviewed, only the marine benthic and grassland studies involved warm-blooded predators, and only one included a warm-blooded herbivore. The authors found evidence that the strongest cascades involved warm-blooded vertebrates (otters and humans), but these communities were primarily in marine environments. However, the authors reported that most studies only evaluate interactions within a small subset of a community, potentially resulting in too little variability in the species manipulated to detect relationships between diversity and the strength of cascades. Most studies were also of insufficient duration and study area size to actually detect ecological impacts that could be suggested to be different from inherent natural variability.

Challenges to Conducting and Interpreting Research and Modeling on Complex and Dynamic Ecological Systems

Many researchers and theoretical ecologists have identified the challenges associated with attempting to study and reach conclusions about very complex and interrelated systems. Ray et al. (2005) finds that determining the ecological effects of large carnivores on the biodiversity, structure, function, and dynamics of ecological systems and any associated ecosystem services may be highly challenging or even impossible to discern. Reasons provided by various researchers include:

- It is difficult to design suitable experiments with spatial and temporal dimensions that are appropriate for the species, populations, communities, and systems involved. This is especially difficult for large carnivore species that are wide-ranging and socially and behaviorally complex, and that use large heterogeneous integrated habitats that may change seasonally (for example, Ray et al. 2005, Ripple and Beschta 2006, Vance-Chalcraft et al. 2007, Engeman et al. 2017)

- Determining change in systems requires that perturbations be created and the results tested, with replications, which may be socially, morally, ethically, and politically impossible with systems involving large carnivores (Ray et al. 2005, Estes et al. 2011)
- Baselines on which to compare changes to determine causal relationships are often already damaged or eliminated, with no remaining or known natural benchmarks against which to measure effects, restricting the ability to discern short-term and long-term equilibrium states with and without predators (Ray et al. 2005, Kozlowski et al. 2008, Estes et al. 2011)
- Finding matched comparison study areas that are sufficiently similar over large spatial areas and over a sufficiently large temporal duration may be difficult and costly at best, and realistically impossible (Ray et al. 2005)
- The existence of many confounding factors can make strong predictions about effects and causation impossible, including abiotic factors such as climate change; weather; differences in site and area productivity; naturally occurring environmental oscillations and “noise”; soil mineralization; and surface and subsurface hydrological dynamics (Ray et al. 2005, Ripple and Beschta 2006, Kauffman et al. 2010, Orrock et al. 2010, Miller et al. 2012, Ripple et al. 2013, Allen et al. 2014, Engeman et al. 2017)
- Human impacts are often discounted or are considered tangentially, despite their often dominant and pervasive influence (Vitousek et al. 1997, Estes et al. 2011), and can confound the ability to experimentally discern functional roles of predators, such as: human actions that have historical caused extirpations or extinctions; habitat fragmentation, especially by development and agriculture; introduction of livestock and/or exotic and invasive species into systems; hunting, poaching, persecution, and roadkill; human intolerance, especially of larger predators; human competition for prey of predators; depletion of prey needed by predators; providing food and structural subsidies; creating predator guilds made up of free-ranging carnivorous pets (cats and dogs) that are subsidized, are recreational killers, and often live in developments bordering large fragmented habitats with already stressed prey populations; and large-scale resource exploitation (for example, Ray et al. 2005, Livaitis and Villafuerte 1996, Palomares et al. 1996, Fedriani et al. 2000, Estes et al. 2011, Fischer et al. 2012, Allen et al. 2017, Haswell et al. 2017)
- Some potentially strong and important correlations related to non-consumptive factors that are in the same statistical direction as commonly recognized correlations may be masked and not considered in interpretation of study results (Peckarsky et al. 2008)
- Valid comparisons of studies evaluated in meta-analyses of multiple studies (where researchers review and reconsider the results of many studies to look for patterns and

problems) have been difficult to make because of differences in spatial and/or temporal scale, differences in factors measured, differences in statistical methods and assumptions, and differences in study methodologies, among other reasons (Briggs and Borer 2005, Hooper et al. 2005, Vanec-Chalcraft et al. 2007, Brashares et al. 2010)

- Most models are oversimplifications of natural systems, and do not include complexities such as anti-predator behavior, more multi-trophic community models, and richer webs of interacting species across heterogeneous landscapes (for example, Holt and Huxel 2007)

- Much of the research related to trophic cascades is often conducted at a small scale and is of short duration in relation to the inherent biological characteristics of the species, communities, and populations (such as reproduction, immigration, generational turnover, or developing ecologically meaningful changes in abundance), and on species that are small, sessile, or localized and easily manipulated (adding or removing individual predator species or guilds), such as invertebrates, arthropods, localized fish populations, and plankton, and are typically in high productivity systems such as streams, lakes, and marine intertidal ecosystems (for example, Duffy 2003, Schmitz et al. 2004, Ray et al. 2005, Briggs and Borer 2005, Beschta and Ripple 2006, Brashares et al. 2010, Estes et al. 2011, Ritchie et al. 2012)

- Research conducted in small temporal and/or geographic scales is difficult or inappropriate to scale up or apply generally to large marine or terrestrial systems, especially for guilds involving wide-ranging, often socially complex predators (for example, bluefin tuna (*Thunnus thunnus*), sharks, wolves, dingoes, or coyotes) (for example, Schmitz et al. 2004, Ripple and Beschta 2006, Brashares et al. 2010, Engeman et al. 2017)

- Research in various systems is being published so rapidly in the last 20 years that it is difficult for researchers to be aware, let alone familiar with, that level of new research results ("information avalanche"), especially if the research is conducted on systems outside of their own disciplinary area (Sergio et al. 2014)

- Statistical analyses, assumptions, and interpretations of results are often appropriately re-evaluated and challenged by other researchers, yet the original papers are cited by other researchers without recognizing these challenges (for example, Ripple and Beschta 2006, Ripple and Beschta 2007, Kauffman et al. 2010, Painter et al. 2015, Litvaitis and Villafuerte 1996, Palomares et al. 1996, Hooper et al. 2005, Balvanera et al. 2006, Wielgus and Peebles 2014, Poudyal et al. 2016)

- The role of outbreaks of parasites and pathogens in ecosystem function is often ignored, although they may be strong mediators of trophic competition and, in some systems, keystone species for driving ecological structure and/or function through acting as a small biomass predator on other larger predatory species within the food web (for example, canine parvovirus in wolves on Isle Royale) (for example, Ray et al. 2005)

- Several studies identify that predator population must reach a certain threshold level at which they become ecologically effective at creating trophic and ecosystem changes, but no one is attempting to determine the threshold level and its effect on humans and livestock (Ray et al. 2005, Letnic et al. 2007, Estes et al. 2011, Ripple et al. 2013)

- Researchers even disagree on the appropriate definitions of and factors involved in ecological functions, trophic cascades, and intraguild predation causing miscommunication among researchers, sampling of inappropriate factors, and misinterpretation of and challenges to cited correlations (Ray et al. 2005, Ripple et al. 2016)

- Poor population sampling to reflect true presence/absence and abundance, resulting in misinterpretations of results, and differences in sampling protocols among studies, making comparisons difficult (for example, Vance-Chalcraft et al. 2007, Wallach et al. 2008, Allen et al. 2014)

- Publication bias, where only positive results are published, may result in important information being withheld that could provide insight into the findings of other studies (Polis et al. 2000, Brashares et al. 2010)

- Not considering adaptive behavior for predator avoidance (for example, changing circadian patterns of activity or habitats used or climbing trees) or increasing predator efficiencies (for example, scavenging), and morphological and biological traits (such as toxic chemicals used by brightly patterned skunks) (for example, Schmitz et al. 2004, Peckarsky et al. 2008, Berger-Tal et al. 2010)

- Many papers repeatedly use the same few examples of trophic cascades, such as studies conducted in Yellowstone NP, Isle Royale, orca-otters-urchins-kelp (for example, Ray et al. 2005, Peckarsky et al. 2008, Estes et al, 2011, Allen et al. 2014, Allen et al. 2017)

- Confusing the roles of, failing to consider, or making inappropriate interpretations of immigration and emigration to account for changes in consumer, competitor or prey abundance; the levels and rates of immigration is very difficult to measure (for example, Duffy 2003, Ray et al. 2005, Briggs and Borer 2005)

- Few studies have attempted to evaluate or quantify the short term and long terms costs of loss of apex predators and mesopredator release (Brashares et al. 2010)

- Confusing and misinterpreting the trophic level and functions that a particular predator plays in a specific food web that may poorly reflect on actual roles in nature (Polis et al. 1989, Ray et al. 2005, Ripple et al. 2016)

- The differences in studying large carnivore-driven system structure and function in relatively unchanging and protected areas in which they were previously extirpated and rapidly reintroduced for management purposes (for example, wolves in Yellowstone National Park), areas in which large carnivores gradually immigrated that are dynamic and largely impacted by humans (for example, wolves in Wisconsin and Minnesota immigrating into areas with high levels of habitat fragmentation and human and livestock densities), urban areas with high levels of human-provided subsidies and habitats, human persecution, intense levels of habitat fragmentation, and/or high levels of subsidized carnivorous pets exist, and neotropical islands (e.g., Ripple and Beschta 2007, Berger et al. 2008, Beschta and Ripple 2012, Fischer et al. 2012, Newsome et al. 2015)

- The repeated citation of a few studies as examples throughout the literature, some of which have been challenged regarding validity of interpretations of results or factors considered (Peckarsky et al. 2008, Prugh et al. 2009, Allen et al. 2017)
- Consideration of whether ecological change to system structure and function occur in a smooth dynamic way or reach thresholds at which major, and possibly irreversible, shifts and perturbations occur (for example Ray et al. 2005, Estes et al. 2011, Ripple et al. 2016).

What Relevant Commonly Cited Articles Are Not Included in Summary Because of Study Discrepancies

Several commonly cited papers in support of the occurrence of trophic cascades in terrestrial systems have serious discrepancies that create problems with the use of their results.

- **Clark (1972):** This early study collected field data on coyote densities, food habits, fecundity, and population growth in relation to prey densities. Documented limitations of the study included inconsistent time spent looking for dens between year, and small sample sizes for the size of the breeding female cohort and litter sizes. Despite these methodology weaknesses, this paper is often cited for its conclusion that long term coyote densities in the Great Basin of Utah appeared to be partly a function of food base, in this case jackrabbits. The study suggests that coyotes did not control jackrabbit populations.
- **Henke and Bryant (1999):** This study conducted in Texas involved heavy removal of coyotes with between 26 and 55 coyotes removed every third month between 1990 and 1992, reducing coyote density from approximately 0.12 coyotes/km^2 to 0.001 coyotes/km^2 (coyote density on untreated control area was 0.14 coyotes/km^2). In addition to such heavy and chronic removals, the authors suggest caution should be used in interpreting the results reported of a substantial decrease in rodent prey richness within nine months of coyote removals. A drought occurred in 1989 through 1990, which decreased forage and may have facilitated dominance of the highly competitive Ord's kangaroo rat over other species present before treatment began. Also, the authors state that logistical and financial constraints limited the number of replications performed, resulting in a low statistical power associated with the results. However, they state that the "weight of evidence" suggested that coyotes exerted top-down influence on the prey community with only weak empirical evidence. The authors also stated that, to consistently lower coyote densities, an annual removal rate of at least 75% is needed.
- **Mezquida et al. (2006):** This paper discusses a potential negative effect of coyote control on sage grouse conservation through release of mesopredators (foxes, badgers, and

ravens) that prey on sage grouse and eggs, depending heavily on Henke and Bryant (1999) and an internal unpublished report prepared by the wildlife biologist at a large private ranch in Utah (Danvir 2000). Rather than coyote predation being either directly or indirectly involved in adversely or positively affecting sage grouse, Danvir (2000) actually places the primary concern with heavy jackrabbit browsing in sagebrush habitat. Golden eagles, another predator of sage grouse, and coyote abundance seemingly increased in response to variability of jackrabbits and ground squirrels. His final conclusion is that he did not consider predator-prey interactions to be the cause of the increase in sage grouse, instead emphasizing the habitat manipulations that had been performed on the ranch to benefit sage grouse was the primary factor. Danvir (2000) suggests that weather drives sage grouse population dynamics relating to vulnerability to predators, especially in winters with deep snow and during spring nesting season, and that the way sagebrush steppe ecosystems are managed related to the quality of sage grouse habitat can magnify or minimize the effects of severe droughts, severe winters, and predation.

- **Atwood and Gese (2007):** In Yellowstone NP after wolf reintroduction, socially dominant coyotes (alpha and beta) responded to wolf presence by increasing the proportion of time spent vigilant while scavenging, with alphas more diligent than betas. Alphas fed first on carcasses, then betas, then others. Increased vigilance, reduced foraging time, changes in group size and configuration, pre-emptive aggression, and retreat to refugia are crucial behaviors to mediating interspecific interactions. Coyotes would aggressively confront wolves, with numerical advantage by coyotes and the stage of carcass consumption influencing whether coyotes were able to displace wolves. In confrontation bouts that coyotes won, both alpha coyotes were present, there were more coyotes than wolves, and wolves were not very invested in winning. These observations are on one wolf pack and should not be generalized to coyote-wolf interactions at a broader scale without further study.
- **Miller et al. (2012):** This paper suggested that coyotes avoided a wolf den, and that coyote predation on rodents away from the wolf den indicated a top-down effect by wolves on coyotes and subsequently on rodents, claiming that restoration of wolves could be a powerful tool for regulating predation at lower trophic levels. The authors argue that making comparisons over time as wolf numbers increase, especially when coupled with spatial comparisons in the study area, can provide evidence that the changes are due to the treatment, and not another confounding factor. These conclusions are based on studying coyote interactions with one wolf den in Grand Teton NP, which is not a sufficient sample size for making conclusions with any correlational strength.
- **Allen et al. (2014):** In Australia, three particular published case studies are commonly cited in support of the mesopredator release theory. Problems exist in each study, including use of circumstantial evidence for MPR of introduced red fox or feral cat coinciding with dingo control. The authors conclude that an absence of reliable evidence that top predator control induced MPR. In the last 10 years, 22 literature reviews and

extended opinion pieces were published. Only three of the 22 discussed caveats or methodological limitations of these three case studies, while other call them anecdotal or circumstantial. Pettigrew (1993) concluded that shooting dingoes increased abundance of feral cats. Abundance sampling was imprecise (800 cats removed from trees, but only 229 observed in sampling surveys), and large bursts of cat abundance occurred in years following rainfall-induced increases in prey availability. Cats shot were prime adults, indicating a large-scale immigration of nonresident cats rather than increased rapid reproduction. Lundi-Jenkins et al. (1993) stated that dingo control resulted in fox detection and extinction of a protected species after dingo control. The study was small scale and the experimental design insufficient for inferring changes in predator population abundance. To suggest that lethal dingo control caused a MPR of foxes from a single opportunistic observation of fox tracks is to extend inferences far beyond the limitations of the data. To infer from the data that dingo control caused the local extinction of the protected species does not recognize the persistence of a nearby colony that did not go extinct in response to baiting but was destroyed by wildfire. Christensen and Burrows (1995) stated that dingo and fox poisoning resulting in an increase in feral cat abundance. The experimental design (imprecise sampling of predator populations) precludes reliable inference because increases in cat abundance coincided with the beginning of 1080 baiting (which does not target cats) after cessation of cyanide baiting (which targets cats, dingoes, and foxes), substantial rainfall events increasing prey densities, and a change in the physical location of the unbaited treatment area, all confounding the results. The three case studies provide no reliable evidence of MPR because of little reliable evidence that dingo populations were affected by the control to any substantial degree, limitations to the experimental designs and predator sampling methods meant that the studies were incapable of reliably evaluating predator responses to dingo control, and MPR remains only one of several plausible explanations for the observations. Although broad patterns among top predator, mesopredators, and their prey have been demonstrated in some contexts and there are good reasons to suspect that these processes also occur for dingoes, MPR cannot be reliably separated from other equally plausible alternative explanations for the suggested interrelationships among dingoes, foxes, and cats. The authors advocate for evidence-based wildlife management approaches that do not unduly risk valuable environmental and economic resources, such as threatened species and livestock.

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Appendix H: WS-Utah Biological Opinion

☑ Concur No Effect Species: *See table 2 p.14 copy Attached
☑ Concur Not Likely to Adversely Affect Species:
☐ No Comment ☑ Not likely to jeopardize
U.S. FWS Utah Field Supervisor
Date 4/5/17

March 30, 2017

Larry Crist
Field Office Manager
Utah Field Office
U.S. Fish and Wildlife Service
2369 West Orton Circle, Suite 50
West Valley City, Utah 84119

Dear Mr. Crist:

The purpose of this Biological Assessment is to request an informal consultation and concurrence of findings pursuant to Section 7 of the Endangered Species Act (ESA). This consultation is specific to WS predator damage management in Utah. We reviewed a compilation of listed species from your Endangered Species website on January 29, 2014 and have evaluated our proposed action in relation to potential impacts that could occur to T/E, candidate and Non-essential Experimental Populations (NEP) species in Utah.

Further, the status of some of the species that occur or could occur in portions of Utah are considered NEP populations because they are classified as reintroduced species. The Secretary of Interior designated the NEP population of these species under Section 10(j) of the ESA, and based on the best available information, determined whether such populations are essential, or nonessential, to the continued existence of the species. Regulatory restrictions may be considerably reduced under an NEP population designation, which is defined as being nonessential to the recovery of the species. For the purposes of Section 7 of the ESA, NEP populations located outside of national wildlife refuges or national parks are treated as if they are proposed for listing. If an NEP population is located within a park or refuge it is treated as if it is listed as a threatened species. This means that Federal agencies are obligated to confer on NEP populations, for any actions authorized, funded, or carried out by them that are likely to jeopardize the continued existence of the species. However, even if an agency action totally eliminated a reintroduced species from an NEP population and jeopardized the species' continued existence, the ESA does not compel a Federal agency to stop a project, deny issuing a permit, or cease any activity.

One peripheral factor pertinent to assessing the risk of adverse affects of WS' activities is the recognition of the importance of having professional assistance, like WS, available to the public with needs for such services. WS operates to assist individuals with damage management problems where there is a need. In the absence of a WS program, or where restrictions prohibit the delivery of an effective program, it is likely that wildlife damage management would be conducted by less trained individuals. These wildlife damage management activities are more likely to cause harm to a listed species. Therefore, WS believes that it is in the best interest of T/E species conservation to maintain professional program functions and to avoid restrictions that could compromise effectiveness to the point that private resource owners elect to conduct their own control rather than utilize government services.

Project Area

The analysis area being considered for purposes of this consultation is the WS program throughout the state of Utah.

Proposed Actions

The proposed action would continue to allow WS-Utah to use a full range of wildlife damage management methods currently authorized and used according to Federal, state and local laws, for the protection of livestock, poultry, designated wildlife species, property and public health and safety (*i.e.*, airports).