FINAL
ENVIRONMENTAL ASSESSMENT:
PREDATOR DAMAGE MANAGEMENT IN NEW MEXICO

Prepared by:

United States Department of Agriculture

Animal and Plant Health Inspection Service

Wildlife Services

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EXECUTIVE SUMMARY

Introduction

Wildlife is a valuable natural resource, long valued by the American public for aesthetic, recreational, emotional, psychological, and economic reasons. Native wildlife in overabundance, or individual animals that have learned to use resources of value to humans, can lead to conflicts. Wildlife can destroy crops and vulnerable livestock, damage property and natural resources, and pose serious risks to human and pet health and safety.

Wildlife Services (APHIS-WS), a program within the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), has a mission to provide federal professional leadership and expertise to resolve wildlife conflicts to help create a balance that allows people and wildlife to coexist. APHIS-WS in New Mexico (WS- New Mexico) responds to requests from the public, government agencies, tribes, private enterprise, and other entities for assistance with managing damage and threats from predatory mammals. WS-New Mexico applies and recommends an integrated wildlife damage management approach (IWDM), which incorporates biological, economic, environmental, legal, and other information sources into its decision-making process. WS-New Mexico's current IWDM activities include many methods for managing wildlife damage including education, advice and implementation of non-lethal and lethal options.

Proposed Action and Scope

WS-New Mexico is proposing to continue its current integrated predator damage management (PDM) activities that respond to requests for assistance to protect agriculture, property, human and pet health and safety, and natural resources from predator damages and threats, and to collect disease data from predators for research. PDM activities may occur on all land classes, including federal, tribal, state, county, municipal and private properties in rural, suburban, and urban areas. WS-New Mexico conducts over 80% of its activities on private lands.

WS-New Mexico performs PDM only when requested by those in need of wildlife damage management assistance; it does not initiate activities on its own accord. WS-New Mexico coordinates, plans, and cooperates with other agencies who have jurisdiction over lands, other resources or human safety, including New Mexico Department of Game and Fish (NMDGF), the New Mexico Department of Agriculture (NMDA), and federal land and resource management agencies. All WS-New Mexico actions are conducted in accordance with applicable federal, state, tribal, and local laws. Operational assistance is only provided after work plans, agreements and other appropriate documents are in place with WS-New Mexico's cooperators and partner agencies.

The proposed action involves WS-New Mexico continuing to recommend or use appropriate methods, either singly or in combination, to resolve damage caused by predator species. These methods include cultural practices such as shed lambing, herding, and guard animals; habitat and animal and behavior modification such as exclusion, chemical repellents, and hazing with pyrotechnics; and lethal operational actions such as trapping and shooting (Appendix A). The predator species that cause threats and damages leading to requests for PDM assistance and evaluated in this environmental assessment are: coyote, black bear, striped skunk, raccoon, cougar (mountain lion), red fox, bobcat, badger, Virginia opossum, gray fox, feral/free-ranging/hybrid dogs, feral and free-ranging domestic cats, western spotted skunk, kit fox, and hog-nosed skunk (Section 1.3). Other species that WS has historically conducted work tasks for include the swift fox, ringtails, red fox, opossum, hooded skunks, long-tailed weasels, and feral domestic ferrets. In addition, New Mexico has a few other species that could invoke work tasks, including the eastern spotted skunk, marten, mink, ermine or short-tailed weasel, and white-nosed coati.

National Environmental Policy Act

WS-New Mexico has prepared this environmental assessment in accordance with the National Environmental Policy Act (Public Law 9-190, 42 U.S.C. 4321 et seq.), the Council on Environmental Quality regulations implementing NEPA (40 CFR 1500 et seq.) and USDA APHIS NEPA Implementing Procedures (7 CFR 372). This EA describes the need for PDM, the potential environmental issues associated with providing PDM, and five alternative ways and levels of providing PDM services to those that request assistance. The EA then evaluates the environmental consequences in a comparative analysis for each environmental issue and alternative.

WS-New Mexico coordinated the preparation of this EA by cooperating and consulting with its partner agencies, including New Mexico Department of Game and Fish (NMDGF), New Mexico Department of Agriculture (NMDA), U.S. Forest Service (USFS), U.S. Bureau of Land Management (BLM), and U.S. Fish and Wildlife Service (USFWS).

How to Comment on the EA

WS-New Mexico will consider all public comments received on the pre-decision EA and make any necessary adjustments to the analysis. The EA will then inform WS-New Mexico's decision on whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI) and a decision on whether or not to select the proposed action or an alternative.

PDM Objectives

WS-New Mexico has established several objectives for PDM to aid in meeting its mission to provide federal professional leadership and expertise to resolve wildlife conflicts.

1. Professionally and proficiently respond to all reported and verified losses or threats due to predators with the PDM approach using the APHIS-WS Decision Model (Slate et al. 1992, APHIS-WS Directive 2.201, Section 2.3.1.2). PDM must be consistent with all applicable federal, state and local laws, APHIS-WS policies and directives, cooperative agreements, memoranda of understanding, and other requirements as provided in any decision resulting from this EA.

2. Implement PDM so that cumulative effects do not negatively affect the viability of any native predator populations.

3. Ensure that actions conducted within the PDM strategy fall within the management goals and objectives of applicable wildlife damage management plans or guidance as determined by the jurisdictional state, tribal, or federal wildlife management agency.

4. Minimize target and non-target effects by using the APHIS-WS Decision Model to select the most effective, target-specific, and humane remedies available, given legal, environmental, and other constraints.

5. Incorporate the use of effective new and existing lethal and non-lethal technologies, where appropriate, into technical and direct assistance strategies.

Needs for WS-New Mexico's PDM Actions (Section 1.11)

PDM assistance is requested of WS-New Mexico when predators cause damage to or threaten livestock, other agricultural resources, property, human/pet health and safety, and natural resources, including other wildlife species.

Need for PDM to Protect Livestock (Section 1.11.2)

- Predators prey on a wide variety of livestock, including cattle, sheep, goats, swine, horses and poultry. Some problems are more seasonal, such as during lambing and calving when livestock are most vulnerable.
- Livestock predation is not evenly distributed so some producers will suffer no damage while others experience serious losses.
- Most producers have attempted non-lethal predation management strategies by the time they request assistance from WS-New Mexico.
- Coyotes are responsible for the majority of livestock losses, followed by bobcats, Mexican gray wolves (covered under other NEPA documents), cougars, black bears and other predators.
- The majority (almost 76%) of requests to WS-New Mexico for PDM assistance are related to livestock damages, and the vast majority (78%) of the livestock losses were on privately-owned lands.

Need for PDM to Protect Other Agricultural Resources and Property (Section 1.11.3).

- Field crops are damaged by coyotes, black bears, badgers, skunks, and fox.
- Fruit, nut crops, vineyards, and beehives may also be damaged by bears.
- Predators, such as foxes and badgers, can burrow in improved or planted pasture, inhibiting the use of planting and mowing equipment and damaging the equipment.
- Predators also damage buildings and structures (including homes, sheds, barns, coops, etc.), trying to gain access for food or other resources, and undermining the structure's foundation.
- Bears, coyotes, skunks, and badgers damage irrigation pipe systems. These and other predators also burrow into dikes and dams, damaging barriers and liners.
- Skunks, raccoons, coyotes, and Virginia opossums destroy gardens, lawns, or turf farms. They can live under homes, destroying insulation and other components, and creating health concerns with feces.

Need for Protecting the Public and Pets from Predators (Section 1.11.4)

Some predators have adapted to using human-altered habitats where they find abundant food, water and shelter inadvertently provided by humans.

- Through habituation, some individual animals lose their fear of humans and behave aggressively. While attacks on people are very rare, they appear to be increasing.
- The majority of requests for assistance in this category are from coyote conflicts with pets.
- Disease transmission risks from predators include rabies (risk to humans, and pets), distemper (risk to pets), parvovirus (risk to dogs), leptospirosis (risk to humans and pets), raccoon and skunk roundworm (risks to humans and pets), and several other pathogens.

- Predator conflicts at airports can also threaten air traffic safety, for example when a plane strikes an animal during takeoff or landing.

Need for Natural Resources Protection (Section 1.11.5) Under some circumstances, predators can cause additive constraints on the ability of some sensitive or vulnerable game species to reproduce and have healthy populations. When identified by NMDGF as necessary, it may request that WS-New Mexico assist with PDM to protect species under their jurisdiction, such as mule deer, elk, pronghorn antelope, and bighorn sheep.

Need for Assistance with Disease Surveillance (Section 1.11.6)
WS-New Mexico is often requested to collect blood, tissue, or fecal samples for the APHIS-WS National Wildlife Disease Surveillance and Emergency Response Program, and other concerned agencies and citizens. WS-New Mexico can efficiently collect samples from animals around the state because it can do so in conjunction with its other routine operations so that no additional animals need to be captured or killed. The information reported by WS-New Mexico is used by other agencies and programs in disease mitigation and response decisions.

Alternatives Evaluated in Detail (Section 2.2)

The following PDM alternatives are evaluated in detail in the EA.

Alternative 1. Proposed Action/No Action Alternative- Continue WS-New Mexico Predator Damage Management Activities. The proposed action is the current PDM program which may fluctuate according to requests for assistance. It includes all available lethal and non-lethal operational and technical assistance.

Alternative 2. WS-New Mexico Provides Lethal and Non-lethal Technical Assistance and only Non-lethal Preventive and Corrective Operational Assistance. WS-New Mexico could provide lethal and non-lethal technical assistance, and/or non-lethal operational assistance, but would not provide lethal operational assistance.

Alternative 3. WS-New Mexico Provides Non-lethal PDM Assistance before Lethal Assistance. WS-New Mexico would provide both technical assistance and operational assistance, but reasonable application of non-lethal methods would have to be shown ineffective to resolve the damage/threat before WS-New Mexico could take lethal action. WS-New Mexico would not provide proactive lethal assistance, and lethal PDM assistance could not be provided until WS-New Mexico has confirmed and recorded that reasonable non-lethal actions have not resolved the problem.

Alternative 4. WS-New Mexico Provides PDM Lethal Assistance Only for human/pet safety or to protect ESA listed Species. WS-New Mexico provides full PDM assistance, including lethal and non-lethal assistance, only when requested for protecting human/pet health or safety or to protect federally-listed species. All other assistance would only apply non-lethal methods and/or technical assistance.

Alternative 5. No WS-New Mexico involvement in PDM Activities. WS-New Mexico would not conduct PDM activities in New Mexico. PDM would still be implemented by other legally authorized entities, such as NMDGF, USFWS, property owners, and commercial PDM companies.

All of the alternatives, except Alternative 5 (No WS-New Mexico PDM Activities), incorporate the APHIS-WS Decision Model as part of PDM for evaluating each damage request and formulating the most appropriate strategy to address the situation, given the constraints of the alternative. The APHIS-WS Decision Model is a professional problem-solving process similar to an adaptive management strategy used by other professionals including wildlife managers. All of the alternatives, except Alternative 5, would include all protective measures included in the Proposed Action (Section 2.4), as applicable, including APHIS-WS policies and relevant state laws and regulations.

WS-New Mexico is not the only entity that can provide IWDM assistance in New Mexico. Government, private entities, and others may request assistance from available local commercial wildlife control operators (WCOs) or from NMDGF. Landowners and their agents may also attempt to resolve predator damage and threats as provided by state law and regulation, but they may not have the necessary effective equipment or proficiency in its humane, safe, and effective use compared to that available from WS-New Mexico and commercial WCOs (Section 3.4.2).

What PDM Methods Are Available to WS-New Mexico? (Section 2.3.1.8, Appendix A)

Implementing non-lethal methods, such as husbandry or structural barriers, are generally the responsibility of the property owners/requesters. Depending on the circumstances of a particular PDM situation, lethal methods may be needed to address the immediate problem during the time period while non-lethal methods are implemented. The APHIS-WS Decision Model provides for the consideration of lethal and non-lethal methods, allows WS-New Mexico to use and recommend the most effective and practical methods available, while accounting for the many legal, logistical, biological, ethical, and environmental variables in each unique damage situation.

- **Non-lethal methods:** Non-lethal methods can be used to disperse, prevent, restrict access, or otherwise make an area unattractive to predators causing damage, thereby reducing the risk that predators can cause damage or threats at the site and immediate area. Non-lethal methods are always given priority by WS-New Mexico personnel when addressing requests for assistance, when applicable and effective (WS Directive 2.101).
- **Lethal methods:** After receiving a request for assistance and conducting a field review, trained and certified WS-New Mexico personnel may determine that lethal methods are appropriate. Lethal methods are often used to reinforce non-lethal methods, to remove animals that have been identified as causing damage or posing a threat to human safety, and/or to reduce the risk of depredation reoccurring in an area where it has occurred in the past. The use of lethal methods results in temporary and small local reductions of the numbers of predators in the area where damage or threats are occurring or are expected to reoccur.

Issues Evaluated (Section 3.2) **and Environmental Consequences** (Chapter 3)

Effect of PDM on Predator Species Populations (Section 3.5)

A variety of sources of mortality affect predator populations, including: intentional and unintentional take by WS-New Mexico; removals by others including NMDGF, hunters, trappers, commercial wildlife control operators; aerial take of coyotes under NMDGF permit; reported landowner take; collisions with vehicles or other sources of mortality that are reported to NMDGF; and unreported sources. The analysis of PDM effects on the predator species evaluated in the EA includes detailed reviews of the scientific literature, detailed data from WS-New Mexico Management Information System (MIS) that tracks WS-New Mexico PDM activities, and recorded data on lethal take from NMDGF for all other sources.

The magnitude of effects on each species' populations was determined quantitatively, based on population estimates determined from the literature and/or NMDGF data, annual maximum sustainable harvest levels based on the literature, and the cumulative take data. This information was then compared to population trends for each species as determined by NMDGF. All calculations of the impacts to predator species use the most conservative approach, selecting the highest projected WS-New Mexico take compared to the lowest and most conservative estimated population numbers. The direct and cumulative effects on the population in Table S-1 show that WS-New Mexico's projected maximum for future take under the current program (Alternative 1), when combined with all known sources of mortality, is well below the maximum sustainable harvest levels set for each species.

Table S-1 Projected direct and cumulative effects of WS-New Mexico's PDM on predator populations (Tables 3.3 through 3.17).

Species	Projected annual WS-New Mexico take as % of population	Projected annual cumulative take as a % of the population	Annual maximum sustainable harvest
Coyote	3.1	8.2	60%
Black Bear	0.1	11	20%
Striped Skunk	0.6	1.0	60%
Hog-nosed Skunk	< 0.1	< 0.1	60%
Spotted Skunk	< 0.1	< 0.1	60%
Raccoon	< 0.1	0.7	16.5%
Cougar	0.2	8.9	11%
Red Fox	< 0.1	4.6	20%
Gray Fox	< 0.1	9.7	20%
Kit Fox	< 0.1	1.4	20%
Swift Fox	0.1	0.8	20%
Badger	< 0.1	0.9	10%
Bobcat	0.05	5.6	10%
Feral and Free-ranging Cat	n/a	n/a	unknown
Virginia Opossum	0	0	Unknown but population is stable
Feral and Free-ranging Dog	n/a	n/a	Unknown

Alternative 1 (Proposed Action). Table S-1 shows that the current and projected direct and cumulative take under the proposed action are well below maximum sustainable harvest levels as determined by a review of the available scientific literature. All predator species populations are stable as determined by NMDGF. The analysis in the EA indicates that WS-New Mexico is not and would not adversely impact any native predator populations.

Alternative 2 (Technical and Non-lethal Assistance). WS-New Mexico would have no effect on predator species populations. Other entities would be expected to fill the need for lethal operational assistance to some degree and have a level of take similar to the cumulative take under Alternative 1. Take by other sources would not be expected to near the maximum sustainable harvest levels. Predator populations are expected to be stable.

Alternative 3 (Non-lethal PDM Assistance before Lethal PDM). WS-New Mexico would have slightly less effects on predator species populations compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary. Cumulative levels of take would be expected to be similar to Alternative 1 and would not be expected to near the maximum sustainable harvest levels. Predator populations are expected to be stable.

Alternative 4 (Lethal PDM Only for Human/Pets or T&E Species). WS-New Mexico would have less effects on predator species populations compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal PDM to protect other resources to some degree and have a level of take similar to the cumulative take under Alternative 1. Cumulative take would not be expected to near the maximum sustainable harvest levels. Predator populations are expected to be stable.

Alternative 5 (No WS-New Mexico PDM Activities). WS-New Mexico would have no effect on predator species populations. Other entities would be expected to fill the need for lethal operational assistance to some degree. Without WS-New Mexico technical or non-lethal operational assistance, other entities may be less efficient and effective, and therefore effects on predator species populations would likely be higher than under Alternatives 1-4. Predator populations are expected to be stable.

Impacts on Threatened and Endangered Species (Section 3.6)

Pursuant to the federal Endangered Species Act (ESA), WS-New Mexico consults with the USFWS when its activities may affect any federally-listed threatened or endangered species. NM WS completed a Biological Assessment and Section 7 consultation with USFWS for all federally threatened and endangered species, experimental populations, and proposed candidate species in December 2014. Separate consultations cover the jaguar and Mexican wolf. WS determined "may affect but not likely to adversely affect" for most federally listed species in NM based on species-specific conservation measures and standard operating procedures listed in the Biological Assessment. For a few species, WS determined "no effect" because WS does not anticipate working in areas where those species are found.

WS is cautious when conducting operations in T&E habitat, prior to operations, consultation occurs with other agencies (USFWS and Forest Service). WS conducts activities according to the Biological Assessment 2014, a list of threatened and endangered (T&E) species was obtained from the United States Fish and Wildlife Service (USFWS) for New Mexico. WS incorporates SOP's to minimize potential problems or RPMs/RPAs and T/Cs of BOs previously completed under Section 7 of the ESA.

For the Mexican wolf, Northern aplomado falcon, Sprague's pipit, and Rio Grande cutthroat trout, WS made "may affect, not likely to adversely affect" determinations. In all instances where "may affect" determinations were made, USFWS concurred with WS determinations, and WS has agreed to further consult for any activity within critical habitat for all species.

USFWS issued a Biological Opinion on WS-New Mexico's potential effects on the federally endangered Mexican wolf which determined that the proposed lethal predator activities to protect livestock could adversely affect grey wolves but would not jeopardize the continued existence of the gray wolf in New Mexico. WS-New Mexico has incorporated the terms and conditions associated with reasonable and prudent measure required in the Biological Opinion (Sections 3.6.4.6 and 2.4, B.2). WS-New Mexico also implements the USFWS non-mandatory conservation recommendations to further minimize the potential for taking federally listed wolves and has developed SOP's to avoid future inadvertent take of a Mexican wolf.

California condors are not currently found in New Mexico but have been considered in the EA based on the potential for condors to travel into New Mexico from planned release sites in neighboring states. When condors are released in sites near the New Mexico border, WS-New Mexico would initiate Section 7 consultation and adopt necessary protective measures to avoid jeopardizing condors in New Mexico. WS has also contacted Peregrine Fund staff, who monitor condor movements through radio and satellite telemetry, to ensure that NM WS staff are notified when condors disperse into NM. WS field staff will remove equipment that has the potential to cause condor take from areas where condors localize.

Alternative 1 (Proposed Action). WS-New Mexico and has completed appropriate ESA consultations with USFWS to avoid jeopardy to listed species. WS-New Mexico has recorded no unintentional take of listed species between FY15 and FY19. WS-New Mexico Take of Mexican grey wolves that is permitted and requested by the USFWS is covered under other NEPA documents and will not be discussed further in this EA. WS New effects on T&E species are expected to continue to be minimal. WS-New Mexico would continue to conduct PDM to protect T&E species.

Alternative 2 (Technical and Non-lethal Assistance). WS-New Mexico would have less effects on T&E species compared to Alternative 1. T&E species would not benefit from lethal PDM conducted by WS-New Mexico for T&E species protection. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher risks to T&E species than under Alternative 1.

Alternative 3 (Non-lethal PDM Assistance before Lethal PDM). WS-New Mexico would have slightly less effects on T&E species compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree if lethal PDM is deemed immediately necessary, potentially resulting in higher risks to T&E species than under Alternative 1.

Alternative 4 (Lethal PDM Only for Human/Pets or T&E Species). WS-New Mexico would have less effects on T&E species compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher risks to T&E species, than under Alternative 1. WS-New Mexico would continue to conduct PDM to protect T&E species.

Alternative 5 (No WS-New Mexico PDM Activities). WS-New Mexico would have no effect on T&E species. T&E species would not benefit from all PDM conducted by WS-New Mexico for T&E species protection. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher risks to T&E species. Without WS-New Mexico technical or non-lethal operational assistance, other entities may be less efficient and effective, and therefore adverse effects on T&E species would be expected to be higher than under Alternatives 1-4.

Effects on Other Species Taken Unintentionally (Section 3.7)

WS-New Mexico lethally takes a small number of animals unintentionally each year, an average of 63 animals, with an additional 23 animals captured and freed. WS-New Mexico minimizes unintentional take by following the protective measures outlined in this EA (Section 2.4).

Alternative 1 (Proposed Action). WS-New Mexico's PDM activities lethally take very few individual animals unintentionally and activities are highly selective for specific predator species. WS-New Mexico's unintentional take is expected to remain negligible.

Alternative 2 (Technical and Non-lethal Assistance). WS-New Mexico would likely take fewer individual animals unintentionally compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of take compared to Alternative 1.

Alternative 3 (Non-lethal PDM Assistance before Lethal PDM). WS-New Mexico would likely take slightly fewer individual animals unintentionally compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary, potentially resulting in higher unintentional take compared to Alternative 1.

Alternative 4 (Lethal PDM Only for Human/Pets or T&E Species). WS-New Mexico would likely take fewer individual animals unintentionally compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of take compared to Alternative 1.

Alternative 5 (No WS-New Mexico PDM Activities). WS-New Mexico would have no unintentional take of individual animals. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher unintentional take. Without WS-New Mexico technical or non-lethal operational assistance, other entities may be less efficient and effective, and therefore effects on species taken unintentionally would be expected to be higher than under Alternatives 1-4.

Potential for WS-New Mexico PDM Activities to Contribute to or Cause Ecological Trophic Cascades (Section 3.8)

Some people have expressed concerns that by removing top level predators in the food web, APHIS-WS and WS-New Mexico's PDM activities may indirectly and negatively affect ecological interrelationships and biodiversity. However, due to the targeted nature of predator removals including their short duration, small geographic scope, and low proportion of take, the localized DPM activities are not expected to create this change. The analysis concludes that WS-New Mexico's PDM actions under the current program, even at a maximum projected level and combined with other sources of mortality, would not be expected to cause negative ecological impacts with respect to apex predators, biodiversity, ecosystem resilience, ecosystem services, mesopredator release, or trophic cascades.

Alternative 1 (Proposed Action). The effects of WS-New Mexico PDM activities on predator species populations are temporary, localized, and of low magnitude. It is highly unlikely that WS-New Mexico's current and projected direct and cumulative take will contribute to any trophic cascades.

Alternative 2 (Technical and Non-lethal Assistance). WS-New Mexico would have no take. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of take compared to Alternative 1. However, it is highly unlikely that take by other entities will contribute to any trophic cascades.

Alternative 3 (Non-lethal PDM Assistance before Lethal PDM). WS-New Mexico would have slightly less take compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal

PDM is immediately necessary. Cumulative levels of take would be expected to be similar to Alternative 1. It is highly unlikely that cumulative take will contribute to any trophic cascades.

Alternative 4 (Lethal PDM Only for Human/Pets or T&E Species). WS-New Mexico would have less take compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of take compared to Alternative 1. It is highly unlikely that cumulative take will contribute to any trophic cascades.

Alternative 5 (No WS-New Mexico PDM Activities). WS-New Mexico would have less take compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of take compared to Alternative 1. It is highly unlikely that cumulative take will contribute to any trophic cascades.

Humaneness and Ethics Related to WS-New Mexico's Use of PDM methods (Section 3.9)

IWDM often involves directly capturing, handling, 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. All WS-New Mexico field personnel strive to undertake these activities as ethically and humanely as possible under field conditions. When implementing PDM management activities, APHIS-WS evaluates all potential tools for their humaneness, effectiveness, ability to target specific offending individuals, 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. A detailed analysis of the scientific and professional literature and the science-based work of the Association of Fish and Wildlife Agencies (AFWA) in developing best management practices for recreational use of capture methods supports the WS-New Mexico's methods and approach to minimizing the potential for animal suffering.

From FY 2015 through 2019, the M-44 with sodium cyanide, aerial shooting, firearms, neck snare and foothold trap were the most consistently used methods for lethal take of many target predator species. Aerial shooting, M-44, and firearms, and, to a lesser degree, neck snares and foothold traps were used for lethal take of coyote, which was by far the species with the highest lethal take. Cage traps are also commonly used for smaller predators such as skunks. Black bears are primarily caught with foot snares and shot with firearms. Cougars are mostly captured with trailing dog and humanely shot with firearms or captured with leg hold snares. Other than M-44s for lethal take of coyotes, chemical methods such as sodium nitrate and the livestock protection collar with compound 1080 are rarely used in the field by WS-New Mexico. Chemical euthanasia and immobilizing drugs used infrequently by NM WS at this point and time, primarily for assistance on research projects in conjunction with other agencies. WS-New Mexico has plans to certify additional employees in I & E (Immobilization & Euthanasia) training. The methods used are highly selective for target animals, with low unintentional takes of predator and non-predator species during WS-New Mexico PDM activities. The type of equipment and application of the set, when used by experienced and proficient personnel such as WS-New Mexico and WCOs, helps to increase the potential for humaneness.

Alternative 1 (Proposed Action). WS-New Mexico follows APHIS-WS training, Directives, and ethics policies. WS-New Mexico also follows state laws and regulations and utilizes BMPs, expertise, and highly selective methods to uphold high standards of humaneness and ethics.

Alternative 2 (Technical and Non-lethal Assistance). WS-New Mexico would continue to uphold the same standards as under Alternative 1. In addition, some people may feel it is unethical and inhumane not to take lethal measures to protect domestic animals from predation, if necessary. Other entities would be expected to fill the need for lethal operational PDM to some degree. However, technical assistance would not compensate for private entities lack of experience in lethal PDM, likely resulting in less humane and ethical practices compared to Alternative 1.

Alternative 3 (Non-lethal PDM Assistance before Lethal PDM). WS-New Mexico would continue to uphold standards under Alternative 1. However, in cases where lethal PDM is deemed immediately necessary, it may be less humane and ethical to delay immediate lethal action. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary, potentially resulting in less humane and ethical practices as compared to Alternative 1.

Alternative 4 (Lethal PDM Only for Human/Pets or T&E Species). WS-New Mexico would continue to uphold standards as under Alternative 1. In addition, some people may feel it is unethical and inhumane not to take lethal measures to protect domestic livestock from predation, if necessary. Other entities would be expected to fill the need for lethal operational PDM to some degree. However, technical assistance would not compensate for private entities lack of experience in lethal PDM, likely resulting in less humane and ethical practices compared to Alternative 1.

Alternative 5 (No WS-New Mexico PDM Activities). WS-New Mexico have no effect on humaneness and ethics. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in less humane and ethical practices. Without WS-New Mexico technical or non-lethal operational assistance, other entities may be less humane and ethical compared to Alternatives 1-4.

Potential Impact on the Environment and Risks to Human and Domestic Animal Health and Safety from PDM Methods (Section 3.10)

Based on available APHIS-WS and WS-New Mexico data, a comprehensive review of the relevant scientific literature, and WS Directives for ensuring safe and careful use of mechanical/physical methods, lead ammunition, and chemical methods, the potential for adverse impacts and risk to human health and safety, including members of the public, hunters, recreationists, and WS-New Mexico field personnel, was found to be low for all methods, especially as used by trained and experienced WS-New Mexico field personnel.

Alternative 1 (Proposed Action). The analysis of impacts on soil, water, and terrestrial and aquatic species indicates there would be little to no effect on the environment from WS-New Mexico's use of mechanical/physical methods. Risks to humans and domestic animals from WS-New Mexico's use of mechanical/physical methods are very low on private lands and highly unlikely on public lands due to short duration and protective measures.

Impacts of lead on soils, water, plants, aquatic species, and invertebrates from WS-New Mexico sources of lead is negligible. Impacts of lead on birds and terrestrial mammals from WS-New Mexico sources are low. Risks to humans and domestic animals from WS-New Mexico sources of lead are very low.

The analysis of impacts on soil, water, and terrestrial and aquatic species indicates there would be little to no effect on the environment from WS-New Mexico's use of chemical methods. Risks to humans and domestic animals from WS-New Mexico's use of chemical methods are very low to negligible due to protective measures.

<u>Alternative 2 (Technical and Non-lethal Assistance)</u>. WS-New Mexico's effects on the environment, humans, and domestic animals would be less than Alternative 1. Other entities would be expected to fill the need for lethal operational PDM to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.

WS-New Mexico's effects on the environment, humans, and domestic animals would be less than Alternative 1. Other entities would be expected to fill the need for lethal operational PDM to some degree, however since chemical methods are limited for other entities, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.

<u>Alternative 3 (Non-lethal PDM Assistance before Lethal PDM)</u>. WS-New Mexico's effects on the environment, humans, and domestic animals would be similar to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.

WS-New Mexico's effects on the environment, humans, and domestic animals would be slightly less than Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.

WS-New Mexico's effects on the environment, humans, and domestic animals would be slightly less than Alternative 1. Other entities would be expected to fill the need for lethal operational PDM to some degree, however since chemical methods are limited for other entities, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.

<u>Alternative 4 (Lethal IIDM Only for Human/Pets or T&E Species)</u>. WS-New Mexico's effects on the environment, humans, and domestic animals would be less than Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational PDM to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.

WS-New Mexico's effects on the environment, humans, and domestic animals would be less than Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational PDM to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.

WS-New Mexico's effects on the environment, humans, and domestic animals would be less than Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational PDM to some degree, however since chemical methods are limited for other entities, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.

Alternative 5 (No WS-New Mexico PDM Activities). WS-New Mexico would have no effect on the environment, humans, and domestic animals. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals. Without WS-New Mexico technical or non-lethal operational assistance, effects on the environment, humans, and domestic animals would be expected to be higher than under Alternatives 1-4.

WS-New Mexico's use of lead would have no effect on the environment, humans, and domestic animals. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals. Without WS-New Mexico technical or non-lethal operational assistance, effects on the environment, humans, and domestic animals would be expected to be higher than under Alternatives 1-4.

WS-New Mexico would have no effect on the environment, humans, and domestic animals. Other entities would be expected to fill the need for lethal operational assistance to some degree, however since chemical methods are limited for other entities, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.

Special Management Areas (Section 3.11)

WS-New Mexico is not frequently requested to assist with PDM management within special management areas. It is possible and likely that WS-New Mexico could be requested in the future by livestock permittees, state and federal wildlife management agencies, by the land management agency directly, or by other entities that manage resources adjacent to wilderness or wilderness study areas. WS-New Mexico may respond to requests to: assist with coyote, cougar or bear depredation on livestock where grazing is authorized; protect public health or safety, especially regarding large predators; and protect listed species from any predator; as well as other needs as they are identified by the authorizing agency. WS-New Mexico could also act as an agent to NMDGF for protecting game species such as deer or elk from coyote, cougar predation within special designation areas, as per agreements between wilderness management agencies and NMDGF.

WS-New Mexico conducts all PDM activities on federal lands, including designated wilderness areas (WAs) and wilderness study areas (WSAs) or other special management areas only when assistance is requested, in accordance with MOUs signed with the federal land management agency, and when incorporated into the Annual Work Plans and/or under authorization from the land management agency. All WS-New Mexico PDM assistance is conducted consistent with federal and state laws and regulations, including any legislation establishing or designating a particular SMA. Operations conducted within areas under the jurisdiction of the USFS, BLM, and USFWS are conducted per the respective MOU with APHIS-WS, as well as legislation, regulations, agency manuals and handbooks, and other pertinent agreements, including operation in designated wilderness areas and BLM wilderness study areas. The agency responsible for managing a particular SMA is also responsible for conducting evaluations of consistency with the purposes for which the area was designated (a minimum requirements decision process), when required. PDM activities are allowed within federally-designated wilderness areas and wilderness study areas, and WS-New Mexico coordinates all activities with land management agencies, and follows all pertinent laws, regulations, MOUs, management plans, and agency policy. As applicable, WS-New Mexico also follows all MRA decisions issued by the authorizing agency. Therefore, WS-New Mexico PDM activities would not adversely affect the purposes for which any special management area was established.

Alternative 1 (Proposed Action). WS-New Mexico would respond to PDM requests by land management agencies, state agencies, or livestock permittees on SMAs. WS-New Mexico response would be according to close coordination with the land management agency, MOUs, and applicable laws, agency policies, work plans, and, as applicable, minimum requirements analyses. Current activities are infrequently requested and short duration in SMAs. WS-New Mexico has negligle effects to SMAs.

Alternative 2 (Technical and Non-lethal Assistance). WS-New Mexico effects on SMAs would be less than Alternative 1. Other entities are expected to fill the need for lethal PDM to some degree through other legal methods, as authorized by state agencies in coordination with land management agencies. Effects on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Effects on SMAs from other private entities would be expected to be higher than under Alternative 1.

Alternative 3 (Non-lethal IIDM Assistance before Lethal PDM). WS-New Mexico effects on SMAs would be slightly less than Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, as authorized by state agencies in coordination with land management agencies, if they determine that lethal PDM is immediately necessary. Effects on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Effects on SMAs from other private entities would be expected to be higher than under Alternative 1.

Alternative 4 (Lethal PDM Only for Human/Pets or T&E Species). WS-New Mexico effects on SMAs would be slightly less than Alternatives 1 and 3. Other entities are expected to fill the need for lethal PDM to some degree through other legal methods, as authorized by state agencies in coordination with land management agencies. Effects on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Effects on SMAs from other private entities would be expected to be higher than under Alternative 1.

Alternative 5 (No WS-New Mexico PDM Activities). WS-New Mexico's would have no effect on SMAs. Other entities are expected to fill the need for lethal PDM to some degree through other legal methods, as authorized by state agencies in coordination with land management agencies. Effects on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Without WS-New Mexico technical or non-lethal operational assistance, effects on SMAs from other private entities would be expected to be higher than under Alternatives 1-4.

Meeting WS-New Mexico's Stated Goal and Objectives (Section 3.1.3)

Section 3.13 reviews how the EA addressed WS-New Mexico's goals and objectives. This section is not an environmental impact analysis. The vast majority of issues analyzed had little difference in impact among the alternatives because the Proposed and Current Action, Alternative 1, had very low impacts. However, there was more variation among alternatives in meeting the objectives. Based on the information and analysis in each section, WS-New Mexico's current PDM activities meet the goal and objectives.

Table S-2 compares how the proposed action and alternatives meet the objectives established in Section 1.5.2. The objectives were established to help meet WS-New Mexico's goal of meeting the APHIS-WS mission of professionally supporting the coexistence of humans and wildlife.

Table S-2 Comparison of alternatives in meeting the objectives to support WS-New Mexico's goal to meet the APHIS-WS mission of professionally supporting the coexistence of humans and wildlife

Alternative 1 Proposed Action/No Action Alternative: Continue WS- New Mexico PDM Activities	Alternative 2 WS-New Mexico Provides Lethal and Non-lethal PDM Technical Assistance and Only Non-lethal Preventive and Corrective Operational Assistance	Alternative 3 WS-New Mexico Provides Non-lethal PDM Assistance before Lethal Assistance	Alternative 4 WS-New Mexico WS-New Mexico provides lethal PDM only for human/pet safety or to protect ESA listed species	Alternative 5 No WS-New Mexico PDM Activities
Objective 1. Professionally and proficiently respond to all reported and verified losses or threats due to predators using the PDM approach using the Decision Model. PDM must be consistent with all applicable federal, state, and local laws, APHIS-WS policies and directives, cooperative service agreements, MOUs, and other requirements as required for any decision resulting from the Final EA.				
Meets objective.	Does not meet objective.	Does not meet objective.	Does not meet objective.	Does not meet objective.
Objective 2. Implement PDM such that cumulative effects do not negatively affect the viability of any native predator populations.				
Meets objective.	Meets objective.	Meets objective.	Meets objective.	Meets objective.
Objective 3. Ensure that all PDM activities conducted by WS-New Mexico align with the management goals and objectives of applicable wildlife damage management plans or guidance as determined by the jurisdictional state, tribal, or federal wildlife management agency.				
Meets objective.	Meets objective.	Meets objective.	Meets objective.	Does not meet objective.
Objective 4. Minimize non-target effects by using the Decision Model to select the most effective, selective, and humane remedies available, given legal, environmental, and other constraints.				
Meets objective.	Meets objective.	Meets objective.	Meets objective.	Does not meet objective.
Objective 5. Incorporate the use of appropriate and effective new and existing lethal and non-lethal technologies, where appropriate, into technical and operational assistance strategies.				
Meets objective.	Does not meet objective.	Meets objective.	Does not meet objective.	Does not meet objective.

LIST OF ACRONYMS

ACEC	Area of Critical Environmental Concern
AFWA	Association of Fish and Wildlife Agencies
APHIS	US Department of Agriculture Animal and Plant Health Inspection Service
APHIS-WS	APHIS Wildlife Services
ANAWG	APHIS Native American Working Group
ATOC	APHIS-WS Aviation Training and Operations Center in Cedar City, Utah
ATSDR	Agency for Toxic Substances and Disease Registry
AVMA	American Veterinary Medical Association
AWP	Annual Work Plan
BA	Biological Assessment (Endangered Species Act)
BGEPA	Bald and Golden Eagle Protection Act
BLM	US Dept. of Interior Bureau of Land Management
BMP	Best management practice
BO	Biological Opinion
BOR	Bureau of Reclamation
CDC	Center for Disease Control
CDFW	California Department of Fish and Wildlife
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CVM	Contingent Valuation Method (economic metric)
dB or dBA	Decibels of sound pressure (metric for sound)
DEA	United States Drug Enforcement Agency
EA	Environmental Assessment
Eco-SSL	EPA ecological soil screening levels
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDA	United States Food and Drug Administration
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act

FLIR	Forward Looking Infrared night vision equipment
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Significant Impact
FSA	Farm Services Agency
FSM	Forest Service Manual
FY	Fiscal year
GAO	US Government Accountability Office
GHG	Greenhouse gas
IARC	International Agency for Research on Cancer
IGP	Intraguild predation
IPDM	Integrated predator damage management
IRAS	EPA Integrated Risk Assessment System for lead
IRS	Internal Revenue Service
ISA	Integrated Science Assessment for lead
IWDM	Integrated wildlife damage management
LD_{50}	Lethal dose – the level at which 50% of the study animals die
LIP	Livestock Indemnity Program
LPC	Livestock protection collar
MANLAA or NLAA	May affect, not likely to adversely affect (Endangered Species Act finding)
MBTA	Migratory Bird Treaty Act
MBI	Minimum Background Investigation
MRDP	Minimum Requirements Decision Process for determining consistency of actions with wilderness values
MIS	USDA APHIS Wildlife Service management information system database
MOU	Memorandum of Agreement
MPR	Mesopredator release
NAC	USDA APHIS WS National Aviation Coordinator
NAGPRA	Native American Graves and Repatriation Act of 1990
NASAO	National Association of State Aviation Officials
NASS	National Agriculture Statistics Service
NEPA	National Environmental Policy Act
NF	USDA US Forest Service national forest
NHSRT	National Historic, Scenic, and Recreation Trail
NM	National Monument
NMDA	New Mexico Department of Agriculture
NMDGF	New Mexico Department of Game and Fish
NPS	National Park Service

NRA	National Rifle Association
NRA	National Recreation Area
NRCS	Natural Resources Conservation Service
NRDC	Natural Resources Defense Council
NRM DPS	Northern Rocky Mountain Distinct Population Segment (Endangered Species Act)
NTSB	National Transportation Safety Board
NWRC	USDA APHIS-WS National Wildlife Research Center
OIG	USDA Office of Inspector General
OMB	Office of Management and Budget
OPM	Office of Personnel Management
OSTP	Office of Science and Technology
PDM	Predator damage management
pH	Metric for degree of alkalinity or acidity
PPE	Personnel protection equipment
ppm	Parts per million
RNA	Research Natural Area
SPL	Sound Pressure Level (metric for sound)
TCM	Travel-Cost Method (economic metric)
TTD	Tranquilizer trap device
TWA	Time-weighted average (metric for sound)
TWS	The Wildlife Society
USACE	US Army Corps of Engineers
U.S.C.	U.S. Code [Statute]
USDA	US Department of Agriculture
USFS	United States Forest Service
USFWS	United State Fish and Wildlife Service
USGS	US Geological Survey
WCO	Wildlife control operator
WID	Work Initiation Document
WDM	Wildlife damage management
WS	USDA APHIS-Wildlife Services
WSA	Wilderness Study Area
WS-New Mexico	USDA APHIS-Wildlife Services New Mexico
WSRR	Wild, Scenic, and Recreational River
WTP	Willingness to pay [economic metric)

CHAPTER 1. PURPOSE AND NEED

1.1 INTRODUCTION

This chapter provides the foundation for:

- Understanding why wildlife damage occurs 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 New Mexico;
- Understanding how WS-New Mexico 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, the rationale for preparing an Environmental Assessment (EA), program goals, and decisions to be made by WS-New Mexico;
- Understanding the reasons why private and commercial entities, tribes, and federal, state, and local government agencies request assistance from WS-New Mexico;
- 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-New Mexico for this EA.

Chapter 2 identifies the issues analyzed in detail in this EA and 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). Details of the different wildlife damage management (WDM) methodologies are included in Appendix A. Chapter 3 provides the detailed comparative analysis of the direct, indirect, and cumulative impacts of the proposed action and alternatives on the quality of the human environment.

1.2 IN BRIEF, WHAT IS THIS EA ABOUT?

Wildlife Services (APHIS-WS), a program within the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), provides federal professional leadership and expertise to resolve wildlife conflicts to help create a balance that allows people and wildlife to coexist (Directive 1.201).

APHIS-WS recommends and/or implements a cohesive integrated wildlife damage approach, which incorporates biological, economic, environmental, legal and other information into a transparent wildlife damage management decision-making process, and includes many methods for managing wildlife damage, including non-lethal and lethal options. Although non-lethal methods are considered first, responsible wildlife damage management sometimes requires lethal control to meet cooperators' objectives. In addressing conflicts between wildlife and people, consideration must be given not only to the needs of those directly affected by wildlife damage but also to a range of environmental, sociocultural, economic, and other relevant factors. Federal and state agency and private wildlife managers, including those working for APHIS-WS, must be experienced in determining which predator species are involved, and expertly implementing or recommending the most effective strategy using sustainable methods that balance those considerations.

This environmental assessment (EA) evaluates the impacts of five alternative approaches to managing predator damage PDM in New Mexico, including the current program. The purpose of the EA is to facilitate WS-New Mexico's decision-making in utilizing an integrated predator damage management (PDM) response to requests for assistance to manage damage caused by predators.

This EA is focused on species that are considered meat-eating predators, even if some of them eat food other than meat as part of their diet. Therefore, for the purposes of this EA, we will refer to all these species as "predators". WS-New Mexico assistance provided to requesters for managing predator damage evaluated in this EA is simply a component of the total WS-New Mexico wildlife damage management activities conducted in New Mexico. WS-New Mexico activities that do not involve predators are evaluated in separate NEPA documents.

This EA analyses impacts to determine if a Finding of No Significant Impact (FONSI) or environmental impact statement (EIS) is appropriate. The alternatives considered in this EA vary regarding the degree of WS-New Mexico involvement in PDM, the degree of technical assistance and operational assistance (advice, information, education, and/or demonstrations) and of operational field assistance (active management of offending predators), and the degree of lethal and non-lethal methods available for use. For this EA, the following species are included as predators: coyote (*Canis latrans*), black bear (*Ursus americanus*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor)*, cougar, (*Felis concolor*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), gray fox (*Urocyon cinereoargenteus*), free-ranging/feral dog (*Canis familiaris*), free-ranging/feral cat (*Felis domesticus*), kit fox (*Vulpes macrotis*), hog-nosed skunk (*Conepatus leuconotus*), swift fox (*Vulpes velox*). Other species for which WS has historically conducted work tasks include ringtails (*Bassariscus astutus*), red fox (*Vulpes vulpes*), Virginia opossum (*Didelphis virginianus*), hooded skunks (*Mephitis macroura*), long-tailed weasels (*Mustela frenata*), and feral domestic ferrets (*Mustela putorius furo*). In addition, New Mexico has a few other species that could invoke work tasks, including the Western spotted skunk (*Spilogale gracilis*), marten (*Marten americana*), ermine or short-tailed weasel (*Mustela erminea*), and white-nosed coati (*Nasua narica*).

The goal of WS-New Mexico PDM is to manage predator damage, threats of damage, and risks to human/pet health and/or safety by responding to all requests for assistance, including technical assistance and/or direct operational assistance, regardless of the source of the request, private or public (Section 1.5.2).

WS-New Mexico proposes to continue PDM by responding to requests for assistance d for the protection of livestock; property; human/pet health and safety; and natural resources; as well as collecting disease data for researchers. The EA includes an analysis of the impacts associated with continuing to assist in PDM on all land classes, including federal, tribal, state, county, municipal, airports, and private properties in rural, urban and suburban areas where WS-New Mexico personnel have been and may be requested to assist, based on agreements between WS-New Mexico and the requesting entity. This EA also includes analysis of impacts of four other levels of predator damage management activities in New Mexico both involving and not involving WS-New Mexico.

The proposed action (Alternative 1; Section 2.3.1 and Appendix A), involves WS-New Mexico continuing to use of all appropriate methods, used singly or in combination, to resolve damage caused by predator species included in this EA. These methods include cultural practices such as shed lambing, herding, and guard animals; habitat and animal and behavior modification such as exclusion, chemical repellents, and hazing with pyrotechnics; and lethal operational actions such as trapping and shooting. In most situations, the requester/cooperator are responsible for implementation of non-lethal methods, such as exclusion-type barriers, and some lethal methods, consistent with state law. Resource owners that are given direct PDM assistance by WS-New Mexico are encouraged to use reasonable and effective non-lethal management strategies and sound husbandry practices, when and where appropriate, to reduce ongoing and the potential for conflict situations.

All WS-New Mexico actions are conducted in accordance with applicable federal, state, tribal, and local laws, and in accordance with current agency Memoranda of Understanding (MOUs) and interagency agreements between WS-New Mexico and the various federal and state resource management agencies. WS-New Mexico cooperates with New Mexico Department of Game and Fish (NMDGF), and the New Mexico Department of Agriculture (NMDA), as appropriate, for actions involving PDM.

WS-New Mexico conducts PDM only when a property owner or manager, including government, tribal, commercial, organizational, or private entity, has requested assistance and Work Initiation Documents (WIDs), MOUs, Interagency Agreements, Cooperative Agreements, and/or work plans are in place to authorize the work.

See Sections 2.3.1 through 2.3.5, and Appendix A for details on the five alternatives evaluated in this EA, and Chapter 3 for their associated impacts.

1.3 WHAT SPECIES ARE INCLUDED IN THIS EA?

This EA includes the following predator species (in order of proportion of take by WS-New Mexico; Table 1.1). All species except for free-ranging/feral dogs and cats are managed under state law by the NMDGF, USFWS, or NMDA.

Table 1.1. Predator Species Included in this EA.

Common Name	Scientific Name	Managed By[1]
Coyote	*Canis latrans*	**NMDGF, NMDA**
Black bear	*Ursus americanus*	**NMDGF**
Striped skunk	*Mephitis mephitis*	**NMDGF**
Raccoon	*Procyon lotor*	**NMDGF**
Cougar	*Felis concolor*	**NMDGF**
Red fox	*Vulpes vulpes*	**NMDGF**
Bobcat	*Lynx rufus*	**NMDGF**
Badger	*Taxidea taxus*	**NMDGF**
Virginia Opossum	*Didelphis virginianus*	**NMDGF**
Gray Fox	*Urocyon cinereoargenteus*	**NMDGF**
Free-ranging/feral dog	*Canis familiaris*	**Local Officials**
Western Spotted Skunk	*Spilogale gracilis*	**NMDGF**
Free-Ranging/Feral cat	*Felis domesticus*	**Local Officials**
Kit fox	*Vulpes macrotis*	**NMDGF**
Hog-nosed skunk	*Conepatus leuconotus*	**NMDGF**
Swift fox	*Vulpes velox*	**NMDGF**

1 NMDGF: New Mexico Department of Game & Fish, NMDA: New Mexico Department of Agriculture

The NMDGF manages wildlife classified as game animals or furbearers under New Mexico statutes, which does not include coyotes, skunks, opossum, feral domestic pets, and T/E species. Game animals include the black bear and cougar and furbearers include the mink, weasel, otter, ringtail cat, raccoon, marten, coati, badger, bobcat, red fox, gray fox, kit fox, and swift fox. NMDGF has authority over coyotes, skunks, and opossum in regard to special permits, cases of human health and safety, and depredation trapping on public land beginning April 2022 per Senate Bill 32. NMDA, has authority under New Mexico statutes to manage damage to agricultural and rangeland resources from predatory animals, including but not limited to coyotes. Feral dogs, feral cats, and feral domestic ferrets are the responsibility of County and municipal Animal Control Offices or the County Sheriff Departments. And lastly, T/E species are managed by the U.S. Fish and Wildlife Service (USFWS), but management of these species can be deferred to NMDGF under agreement.

Under State law, NMDGF must respond to complaints from private landowners or lessees when protected wildlife including game and furbearers are causing damage. WS-New Mexico, under a Joint Powers Agreement (JPA) and contract, assists NMDGF with responding to these complaints. WS-New Mexico, under an agreement with NMDA, also responds to agricultural and rangeland resource damage from predators. WS-New Mexico also assists public entities, such as USFWS with the appropriate permits from NMDGF, and Native American Tribes with PDM, when requested. Landowners also have the right to protect their resources from unprotected predatory species without a permit. The goal of WS-New Mexico PDM is to conduct a coordinated program to alleviate predator damage in accordance with plans, goals, and objectives developed to reduce damage pursuant to the JPA and agreement.

A few other species of mammalian predators are, or potentially could be, found in New Mexico and include federally listed threatened and endangered (T&E) species. These species could possibly be encountered during PDM activities targeting the predatory species above or could be a problem themselves. The Mexican gray wolf (*Canis lupus baileyi*), the native population endangered, is believed to be extirpated in New Mexico and elsewhere, has been reintroduced in western New Mexico and eastern Arizona as an endangered nonessential/experimental population. WS-New Mexico's involvement with Mexican gray wolf damage management is covered under other NEPA documents. The Canada lynx (*Lynx canadensis*) was historically not documented in New Mexico, but has shown up in northern New Mexico from recent reintroduction efforts from populations in Alaska and Canada and Colorado, but New Mexico does not list the Canada lynx as a state endangered species. The endangered jaguar (*Panthera onca*), though few records exist for New Mexico, has been photographed in the Peloncio Mountains of southwestern New Mexico. The endangered black-footed ferret (*Mustela nigripes*) is believed to be extirpated from the wild but has been be reintroduced from captive ferret populations on a private ranch under an experimental permit. PDM could be initiated to target predatory species that prey on ferrets or are considered a disease threat.

Potential impacts of WS-New Mexico's involvement with PDM to assist federal and state agencies with the T&E species listed above and their associated damage management in New Mexico are evaluated independently of this EA.

1.4 WHAT IS WILDLIFE DAMAGE MANAGEMENT?

1.4.1 Why do wildlife damage and risks to human health and safety occur?

Wildlife is a valuable natural resource, long enjoyed by the American public for aesthetic, recreational, emotional, psychological, and economic reasons. Native wildlife in overabundance or individual animals that have learned and habituated to use resources supplied by humans, especially food, can lead to conflicts with humans. Introduced, feral, or invasive species may outcompete native species and cause damage to other resources. Wildlife can destroy crops and livestock, damage property and natural resources, including other species valued by humans, and pose serious risks to public and pet health and safety.

Across the United States, wildlife habitat has been substantially changed as human populations expand and land is used for human needs. 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. With this continued and more intensive use of land by humans, introduction of domestic livestock, water resource management, urbanization, and other modern agricultural, cultural, and transportation practices associated with human development have caused substantial changes in the ways that humans and wildlife, especially predators, interact.

Highly adaptable and flexible species often reach unnaturally high densities. Some animals and localized populations may adapt to change by using human infrastructure or concentrated agricultural practices for their life cycle needs, such as obtaining food and water, finding areas to breed or rest. Conflicts include threats to human health and safety.

Wildlife may serve as reservoirs for disease and parasites. Diseased animals living near areas of human activity may transmit those diseases to livestock, people, and/or pets. These diseases may transfer to people directly through physical contact or may be transmitted to people via environmental contamination by feces and even tainted food products such as fresh produce or meat products.

The wild animals themselves do not perceive the same values that humans perceive in the animals or plants they eat, the locations they choose to breed and live, or the health or safety concerns they cause to humans. They are simply using and adapting to the available habitats, including opportunities where humans provide easy food and living space. Wildlife's constant ability to adapt to changes in their environment for meeting their own needs for food, water, and shelter can create tension and conflict where human needs for social and economic security and health and safety overlap.

1.4.2 What types of values do humans have with wildlife?

Schwartz et al. (2003) summarize how human attitudes towards large carnivores has evolved over time in Europe and North America from threats to life and property to utilitarian considerations, to valuing their intrinsic values. Human perceptions, attitudes, and emotions differ depending on how humans desire to "use" different wildlife species and how they interact with individual or groups of animals. For example, seeing a group of deer in a field at dusk may be seen as a positive experience, while seeing the same group of deer feeding in your garden or commercial alfalfa field is frustrating. Watching a coyote feeding on rodents in the snow may be exciting, while having the same coyote foraging for food near or on your pets or farm animals on your property may be highly undesirable and even frightening. Raccoons in the neighboring forest patch may be enjoyable to watch, while the same raccoon in your garbage, henhouse, or attic is intolerable.

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

The values that people hold regarding wild animals differ based on their past and day-to-day experiences, as well as the values held by people they trust. For example, people who live in rural areas that depend on land and natural resources tend to consider wildlife from a more utilitarian viewpoint, such as for hunting. Age and gender also influence viewpoints, with younger people and females tending to feel more emotional towards wildlife (Kellert 1994; Kellert and Smith 2000; Table 1.2):

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

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

As summarized by Lute and Attari (2016), people have strong opinions about killing wildlife, dependent on a myriad of factors, such as social identity and experience and knowledge about different species. 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 to support for conservation. Factors relevant to how people respond to wildlife can include intrinsic value attributions given to humans, some or all animals, 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, and people's needs and desires within the context of their relationship with specific individual animals and species and their intrinsic values and flaws create highly complex attitudes and associated behaviors, including potentially mutually exclusive ones. Also, people may go to great lengths to save an individual identifiable person, but become numb to saving nameless masses ("psychic numbing").

Between 2001 and 2009, Treves et al. (2013) conducted multiple longitudinal surveys in Wisconsin, where deer hunting is an important cultural tradition, and found that respondents increased in agreement with statements reflecting fear of wolves, the belief that wolves compete with hunters for deer (*Odocoileus virginianus*), and inclination to poach a wolf. Based primarily on the conflict for deer, the authors predict widespread, increased calls for lethal control and high quotas in public harvests of wolves. Surveys conducted in 1978 and repeated in 2014 by George et al. (2016) found that attitudes towards all animals were remarkably similar in 1978 and 2014; however, the greatest differences for particularly species were for historically stigmatized species, such as bats, sharks, vultures, coyotes, and wolves, which were significantly more positive in 2014 than in 1978, with significant increases in positive attitudes towards wolves and coyotes. The authors predict that increases in positive attitudes toward predators could also signal increases in social conflicts surrounding their management, especially in areas where these species are abundant or where conflicts with predators are increasing. Conservationists also are still discussing whether nature and wildlife have intrinsic value separate from the contribution they make to human well-being (Vucetich et al. 2015), and whether and how emotions and/or a sophisticated careful accounting by disinterested trustees should enter into policy and decision making (for example, Nelson et al. 2011, Nelson et al. 2016, Treves et al. 2017).

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

In the past, as settlers moved across the West, large predators such as bears, wolves, and cougars were perceived as inherent threats to safety and food supply. These species were feared and humans systematically extirpated or substantially reduced their population sizes in many areas through overhunting, local, state, and federal government and private predator removal programs, and/or habitat destruction. Taxpayer funds that were once used to directly reduce "undesirable" wildlife predator populations, such as wolves or grizzly bears, may now be used to protect and increase their populations and habitats, recognizing their inherent ecological and social values within the framework of potential competition over natural and human resources and values.

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

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

1.4.3 At what point do people or entities request help with managing wildlife damage?

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

Animals cause damage to property, agriculture, economic security, threaten the sustainability of managed or protected wildlife species, and/or threaten human and pet health and safety. When this occurs, there are many situations when people, government agencies, or commercial interests request private companies or federal or state governments to stop or reduce the damage by, removing, or dispersing the individual animals or local groups of animals causing the problems. When damage or losses have previously occurred and can be expected to occur again, people or agencies may request that animals or local groups of animals be removed or dispersed to avoid further losses, even before the damage or losses reoccur. Often, without outside help, people or entities will try to resolve the problems themselves, sometimes by attempting to prevent the damage from re-occurring, such as by building fences and other infrastructure, or by killing animals that they perceive are, and that may or may not be causing the problem, using traps, firearms, or toxic chemicals.

The term "damage" in the case of WDM is consistently used to describe situations where the individual person or entity has determined that the losses caused by wildlife triggers their threshold for requesting assistance or attempting to take care of the problem themselves. "Damage" may be defined as economic losses to property or assets, or threats to human or pet safety. However, "damage" may also be defined as a loss in the aesthetic value of property and other situations where the behavior of wildlife is no longer tolerable to an individual person or entity.

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

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

"Biological carrying capacity," as we use it here, is the maximum number of animals of a given species that can, in a given ecosystem, survive through the least favorable conditions occurring within a stated time interval (in other words, the largest number of animals that can sustainably survive under the most restricting ecological conditions, such as during severe winters or droughts; The Wildlife Society 1980). The “wildlife acceptance capacity,” or “cultural carrying capacity,” is the limit of human tolerance for wildlife or its behavior and the number of a given species that can coexist compatibly with local human populations. Just the presence of a wild animal may be considered threatening or a nuisance to people with low tolerance or inexperience with the ways of wild animals, or when the animals are viewed as cruel, aggressive, or frightening. Those phenomena are especially important because they define the sensitivity of a person or community to coexisting with a wildlife species.

This damage threshold determines the wildlife acceptance capacity. While the biological carrying capacity of the habitat may support higher populations of wildlife, in many cases the wildlife acceptance capacity of people sharing that habitat is lower. Once the wildlife acceptance capacity is met or exceeded in a particular circumstance, people take or request help for taking action to alleviate the damage or address threats.

1.4.4 What are the science and practices of wildlife damage management?

With new science and changing societal values, governmental policies have changed to the extent that native wildlife populations are no longer managed by local, state, and the federal government for population suppression, extirpation from local areas, or even entire removal over large areas or regions, unless such management meets local objectives of protecting other valued or rare wildlife populations or for reducing the threat of the spread of disease. Wildlife damage management focuses on addressing a specific situation, not broad-scale population management. The Wildlife Society, a non-profit scientific and educational association that represents wildlife professionals, recognizes that wildlife damage management is a specialized field within the wildlife management profession, and that responsible wildlife management, including WDM, requires adherence to professional standards.

The Wildlife Society has the following standing position on Wildlife Damage Management (WDM; The Wildlife Society 2016; http://wildlife.org/wp-content/uploads/2016/04/SP_WildlifeDamage.pdf):

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

Adapting the definition of Integrated Pest Management from the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA; Section 1.11.3) to wildlife damage management, Integrated Wildlife Damage Management (IWDM) involves considering and applying options, tools, and techniques, either singly or in combination, for resolving the damage or threat of damage using a strategy that is sustainable and appropriate to the specific project circumstances in a way that minimizes economic, health, and environmental risks. Sustainable wildlife management is defined as “the sound management of wildlife species to sustain their populations and habitat over time, taking into account the socioeconomic needs of human populations” (IUFRO & CPW 2017). When managing wildlife for meeting certain objectives related to damage or threats caused by species identified as “predators,” it is called integrated predator damage management (PDM).

USDAAPHIS-WS uses an Integrated Wildlife Damage Management (IWDM) approach (APHIS-WS Directive 2.105) in which a combination of methods may be used or recommended to reduce wildlife damage. The challenge is to develop strategies that include the most effective combination of techniques, for example, separating the asset to be protected from the problem animals, removing the problem animals before or when they cause the problem, harassing them away, and/or educating the resource owner on how to coexist with the animals or to remove the attractant.

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

The APHIS-WS Directive 2.105 states:

> “The WS program applies the IWDM (commonly known as Integrated Pest Management) approach to reduce wildlife damage. As used and recommended by the WS program, IWDM encompasses the integration and application of all approved methods of prevention and management to reduce wildlife damage. The IWDM approach may incorporate cultural practices, habitat modification, animal behavior management [such as repellents, frightening devices, and physical exclusion], local population reduction [such as removing offending animals or groups of animals] or a combination of these approaches.
>
> The selection of wildlife damage management methods and their application must consider the species causing the damage and the magnitude, geographic extent, duration, frequency, and likelihood of recurring damage. In addition, consideration is given to nontarget species, environmental conditions and impacts, social and legal factors, and relative costs of management options. WS personnel shall apply and use the IWDM approach to efficiently and effectively prevent or reduce damage caused by wildlife. In applying IWDM to wildlife damage management, the WS program may offer technical assistance, direct control, or a combination of both in response to requests for help with wildlife damage problems.”

1.5 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 wildlife damage management 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 threatened and endangered species, and managed wildlife populations), protection of public, private and commercial property and assets; and control of invasive species and wildlife disease vectors. Increasingly, APHIS-WS is responsible for minimizing wildlife threats to public health and safety, as well as to the Nation's vital agricultural base.

APHIS-WS' success is based in its combined programs of integrating fieldwork (operations) with state of the art research of applied wildlife damage management principles and techniques. APHIS-WS' National Wildlife Research Center (NWRC), internationally recognized as a leader in wildlife damage management science. Scientists and support staff are dedicated to finding solutions to challenging wildlife damage management problems related to agriculture, natural resources, property, and human health and safety. NWRC conducts research and develops tools to address dynamic wildlife damage management challenges. APHIS-WS 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. NWRC 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 in peer-reviewed scientific literature and the exchange of technical information by other means, the NWRC provides valuable information to the public and the scientific community, as well as to APHIS-WS' operations.

1.5.1 What is the federal law authorizing Wildlife Services' actions?

APHIS-WS is the federal agency authorized by Congress to protect American resources from damage associated with wildlife. The Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426) states:

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

The Act was amended in 1987 (Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. 426c) to further provide:

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

The 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.

1.5.2 How does Wildlife Services carry out its mission?

APHIS-WS' mission, developed through a strategic planning process, is "to provide leadership in wildlife damage management in the protection of America's agricultural, industrial and natural resources, and to safeguard public health and safety" (APHIS-WS Directive 1.201).

To facilitate long-term strategic planning, APHIS-WS identified a list of core program functions in the APHIS-WS 2020-2024 Strategic Plan (APHIS-WS 2019), including these functions relevant to WS-New Mexico:

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

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….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 through:

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

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

1.5.3 WS-New Mexico goals and objectives

The goal of WS-New Mexico in relation to PDM activities is to meet the APHIS-WS mission of professionally supporting the coexistence of humans and wildlife. WS-New Mexico staff consistently responds to all requests for assistance to meet the following components of the goal:

- 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 (WS Decision Model WS Directive 2.201, Section 2.5.1.2) to evaluate, formulate, and implement or recommend the most effective strategy.
- The recommended strategy for each response intends to effectively 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/or long-term and are often a combination of lethal and/or non-lethal methodologies to ensure effectiveness.

The WS-New Mexico objectives are to:

1. Professionally and proficiently respond to all reported and verified losses or threats due to predators using the PDM approach using the APHIS-WS Decision Model. PDM must be consistent with all applicable federal, state, and local laws, APHIS-WS policies and directives, cooperative service agreements, MOUs, and other requirements as required for any decision resulting from the Final EA.
2. Implement PDM so that cumulative effects do not negatively affect the viability of any native predator populations.
3. Ensure that all PDM activities conducted by WS-New Mexico align with the management goals and objectives of applicable wildlife damage management plans or guidance as determined by the jurisdictional state, tribal, or federal wildlife management agency.
4. Minimize non-target effects by using the APHIS-WS Decision Model (APHIS-WS Directive 2.201; Section 2.5.1.2) to select the most effective, target-specific, and humane remedies available, given legal, environmental, and other constraints.
5. Incorporate the use of appropriate and effective new and existing lethal and non-lethal technologies, where appropriate, into technical and operational assistance strategies.

APHIS-WS' activities are conducted in accordance with applicable federal, state, and local laws, Work Initiation Documents (WIDs), cooperative agreements, agreements for control (Section 1.8), Memoranda of Understanding (MOU) (Section 1.9), and other applicable agreements and requirements, and the directives found in the WS Program Policy Manual, updated April 20, 2016 (https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/sa_ws_program_directives). These documents establish the need for requested work, legal authorities allowing the requested work, and the respective responsibilities of APHIS-WS and its cooperators.

1.5.3.1 How does APHIS-WS ensure the implementation of professional WDM practices?

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

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

Employee characteristics identified in the Code of Ethics (Directive 1.301) include commitment to compliance with legal requirements; honesty; integrity; accountability; continual learning and professional development; showing high levels of respect for people, property, wildlife, and varying viewpoints regarding wildlife and wildlife management; conservation of natural resources; using the most selective and humane methods available, with preference given to non-lethal methods when practical and effective; using the APHIS-WS Decision Model to resolve IWDM problems; providing expertise on managing wildlife damage to the public upon request; and working in a safe and responsible manner. They must also be experienced in working with people, and in using clear strategic skills in applying their experience, expertise, and training in applying the APHIS-WS Decision Model in effective and creative ways (Section 2.3.1.2).

All field personnel are experienced in wildlife management, competent, and are highly trained in a diversity of methods described in in detail in Appendix A, as needed and appropriate, and are trained with periodic refreshers, in:

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

Professional and state agencies, councils, and wildlife management organizations have recognized APHIS-WS and individual employees for their work in wildlife conservation as part of IWDM, including, for recent examples: the Alaska Department of Fish and Game Director's Stewardship Award; recognition for BASH work at Nellis Air Force Base; USFS 2016 Eastern Region Honor Award for work managing feral swine damage on the Wayne National Forest; Michigan Aeronautics Commission Award of Excellence; Michigan Department of Natural Resources 2015 Oscar Warbeck Award for outstanding partnership in managing BASH; USFWS

2016 recognition award for efforts leading to the return of the black-footed ferret to Meeteetse, WY; National Invasive Special Council 2015 Invasive Species Leadership/Aquatic Award; The Wildlife Society 2008 Caesar Kleberg Award for Excellence in Applied Wildlife Research; and the Wolf Recovery Foundation Alpha Award for achievements and contributions benefitting wolf recovery in multiple years. In addition, APHIS-WS received the 2014 Presidential Migratory Bird Federal Stewardship Award for non-lethal localized management of conflicts between raptors and humans.

APHIS-WS personnel also regularly contribute to the development of new management methodologies, publish professional articles in respected journals, and provide presentations at professional conferences.

1.5.3.2 How does APHIS-WS operate?

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

APHIS-WS personnel may also take action directly in response to a request for assistance, called "direct assistance" activities. These actions can include non-lethal techniques such as harassment and/or lethal measures that remove the offending animal(s), such as capturing them with specialized equipment and conducting euthanasia when needed. The actions can occur in urban or field settings, including secured and limited use areas such as military bases and airports. Before wildlife damage management of any type is conducted, a WID must be signed by a representative of WS-New Mexico and the land owner or manager, or, for work on federal lands, an Annual Work Plan is discussed and agreed upon by the land management administrator or agency representative and WS-New Mexico (per MOUs with the USFS and BLM, Section 1.8).

The APHIS-WS Directive 2.101 states:

> "When responding to requests for assistance, WS may provide technical assistance, direct control assistance, and/or research assistance. Technical and direct control assistance…may involve the use of either lethal or non-lethal methods, or a combination of the two. Preference is given to non-lethal methods when practical and effective."

Trained and experienced personnel determine the appropriate PDM methodologies to recommend and/or implement using the APHIS-WS Decision Model (Slate et al. 1992, APHIS-WS Directive 2.201, Section 2.5.1.2, hereafter called the "Decision Model"). Using this Decision Model, after the field employee receives a request for assistance, s/he assesses the problem, evaluates the effectiveness of the various methods available using PDM, recommends the strategy based on short-term and long-term effectiveness and possible restrictions, constraints, and environmental considerations and cost, discusses the options with the cooperator, and formulates the strategy, then provides the appropriate assistance, and the field and/or the cooperator monitors the effectiveness of the results. The use of the APHIS-WS Decision Model is discussed in more detail in Section 2.3.1.2.

The ultimate intent of APHIS-WS personnel responding to a request for assistance is to develop and, when appropriate, implement strategies to alleviate and/or avoid wildlife damage and threats to human/pet health or safety, using one or more of the following strategies:

- Manage the resource being damaged so it is more difficult for the wildlife to cause the damage.
- Manage the wild animals responsible for or associated with the damage in lethal and/or non-lethal ways so they cannot continue to cause damage and potentially train their young or conspecifics to cause such damage, and/or
- Create physical separation of the protected resource and the problem animals so that the damage is inherently minimized.

All APHIS-WS actions are consistent with applicable federal, state, and local laws and regulations (APHIS-WS Directive 2.210). All actions must be consistent with memoranda of understanding and agreements with federal and state agencies, such as the NMDA, NMDGF, USFWS, USFS, or BLM, if the actions involve those agencies. Most importantly, as a federal agency, all APHIS-WS actions must be in compliance with the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Migratory Bird Treaty Act (MBTA), and FIFRA, as well as the federal and state statutes discussed in this EA (Section 1.10.3 and 2.4) and in Appendix B.

When requested to assist with PDM problems, the WS-New Mexico decision is whether or not to participate based on authority, jurisdiction, funding, and a professional determination of the scientific appropriateness and effectiveness of the proposed strategy. NMDGF is authorized to control the threat of predator-related damage to wildlife populations under their authority using hunting seasons and administrative removals of predators. The USFWS is authorized to manage ESA-listed species, migratory birds, and eagles (Section 1.10.3 and Appendix B). Therefore, when requested by NMDGF or the USFWS to conduct PDM for protection or management of species under their jurisdiction, especially if the requested action involves localized population reduction, WS-New Mexico evaluates the potential effectiveness and appropriateness of their involvement before making a final decision to assist. WS-New Mexico considers whether such actions would be strategically planned to occur at a specific time when the managed wildlife population is vulnerable to predation, such as on the winter range or during calving, lambing, or nesting, and when population reductions are determined to be necessary on a temporary and short-term basis.

WS-New Mexico activities are described in detail in Section 2.3.1 (Alternative 1) and Appendix A.

1.6 WHAT ACTIONS ARE OUTSIDE OF WILDLIFE SERVICES AUTHORITY?

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

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 (FLPMA) for the BLM, and the Forest Service Organic Act of 1897 and the Multiple Use-Sustained Yield Act of 1960 for the Forest Service. Congressional appropriations support the implementation of these authorities. In contrast, WS-New Mexico only addresses predator damage management upon request (Section 1.5 and WS Directive 2.201).

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

APHIS-WS does not make wildlife management decisions. Each state has full authority and jurisdiction to manage the native wildlife within its boundaries, unless authority is granted to another governmental entity, such as the US Fish and Wildlife Service per the ESA, MBTA, or the Bald and Golden Eagle Protection Act (BGEPA).

In New Mexico, most native wildlife species are managed by NMDGF per New Mexico Revised Statutes (NMSA) Title 17. The USFWS has statutory authority to manage federally listed T/E species through the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531-1543, 87 Stat. 884) and migratory birds under the Migratory Bird Treaty Act of 1918 (16 U. S. C. 703-711; 40 Stat. 755), as amended. The State of New Mexico has its own Endangered Species Act (NMSA 17.2.41).

WS-New Mexico has no authority for determining the appropriate management of wildlife populations that are under the jurisdiction of NMDGF and USFWS per their statutes, regulations, and species management plans and strategies, or management of species regulated in accordance with the ESA, the MBTA, or the BGEPA. Rather, WS-New Mexico responds to governmental and non-governmental requesters for assistance in managing wildlife damage and threats.

For more details on the various federal and state laws regarding wildlife management and protection, see Section 1.10.3 and Appendix B.

1.7 WHAT ARE THE STATE OF NEW MEXICO'S AUTHORITIES AND OBJECTIVES FOR MANAGING WILDLIFE DAMAGE

It is APHIS-WS policy to comply with applicable state laws (APHIS-WS Directive 2.210) and APHIS-WS' practice to cooperate with states in managing wildlife damage. NMDGF manages wildlife under its jurisdiction.

The mission of NMDGF is to:

provide and maintain an adequate supply of wildlife and fish within the state of New Mexico by utilizing a flexible management system that provides for their protection, conservation, regulation, propagation, and for their use as public recreation and food supply.

NMDGF has the primary responsibility to manage all protected and classified wildlife in New Mexico, except federally listed T/E species, regardless of the land class on which the animals are found (New Mexico Revised Statutes (NMSA) Title 17), including predators considered furbearers and big game. NMDGF is authorized by State law to contract with WS for reducing damage caused by big game and furbearers. Landowners, lessees or any other person or entity may obtain a permit to take furbearers and big game species causing excessive damage to property in New Mexico (NMSA 17.3.31, 17.5.3). NMDGF is mandated that it resolve predator damage for private landowners or lessees (NMAC 19.30.2 and 6). NMDGF also issues permits for aerial gunning per Section 13 of the Fish and Wildlife Act of 1956, as amended, to landowners, lawful tenants, and lessees to take predatory animals (NMSA 17.3.45-47). The Director of the Department of Game and Fish may grant a permit to any person to carry out acts which are prohibited by the Airborne Hunting Act (NMSA 17-3-43). Permits shall be granted only to protect or aid in the administration or protection of land, water, wildlife, livestock, domesticated animals, human life or crops. Each person operating under a permit shall report to the Director of the Department of Game and Fish each calendar quarter, the number of animals so injured, captured or killed (NMSA 17-3-47).

Per state statute, NMDA has the authority to manage predatory animals that depredate agricultural and rangeland resources. NMDA is authorized to cooperate with WS to conduct PDM. NMDA also regulates the pesticide laws in New Mexico. WS registers any pesticides it uses with NMDA. WS personnel that use restricted pesticides in their job must be certified pesticide applicators through NMDA. The M-44, Livestock Protection Collar (LPC), and large gas cartridge are the only predacides registered for use and pesticide users must be registered to use them under NMAC 21.17.57.1-11.

In New Mexico, black bear and cougar management is the responsibility of the NMDGF. Generally, either the NMDGF or WS-New Mexico receives requests directly to handle damage to livestock and/or threats to human/pets health or safety caused by black bear or cougar. The NMDGF may choose to ask WS-New Mexico or other non-departmental personnel to respond to the request for assistance with specific animals.

Free-ranging and feral dogs can be threats to human health and safety, agriculture, natural resources, and property (Bergman et al. 2009; Section 3.5.11). In New Mexico, dog control laws are the responsibility of local governmental agencies. County or municipal animal control officials or County sheriffs are responsible for responding to feral or stray dogs that threaten, damage, or kill livestock. WS policy allows WS personnel to assist in feral dog management at the request of local authorities upon approval of the WS-New Mexico State Director.

APHIS-WS Directive 2.340 regarding responding to damage caused by feral, free-ranging, and hybrid dogs states that such actions will be coordinated either for each project or programmatically with state, local and tribal authorities before taking action, and that each state will develop a state-side policy (2.325NM). Per the APHIS-WS Directive, the field employee capturing any free-ranging dog that is determined to be a pet they shall inform the owner, if possible, as soon as is practical. WS-New Mexico is only infrequently called to respond to feral or free-roaming dog complaints (slightly more than 2% of all responses of the species in this EA), as these are usually handled by local officials.

WS-New Mexico will abide by the policies outlined in Senate Bill 32 (section 2.4.4.7) regarding PDM activities on public land in New Mexico.

NMDGF also has developed numerous management objectives for managed species into rules for New Mexico. NMDGF has management rules for:

- Deer (19.31.13 NMAC)
- Elk (19.31.14 NMAC)
- Bear and Cougar (19.31.11 NMAC) and
- Antelope (19.31.15 NMAC)

Portions of these rules as appropriate are integrated into this EA as needed to support needs and analyses within the context of appropriate state policies.

1.7.1 HOW DOES WS-NEW MEXICO WORK WITH NMDGF, NMDA, AND COUNTIES?

When assistance is requested from NMDGF or NMDA for a predator damage-related problem that involves a state agency, WS-New Mexico cooperates with the state agency per applicable New Mexico statute and regulations, and in accordance with guidelines, restrictions, and objectives set forth by NMDGF management and conservation plans and cooperative agreements.

Under State law, NMDGF must respond to complaints from private landowners or lessees when protected wildlife including game and furbearers are causing damage. WS-New Mexico, under a Joint Powers Agreement (JPA) and contract, assists NMDGF with responding to these complaints. WS-New Mexico, under an agreement with NMDA, also responds to agricultural and rangeland resource damage from predators. WS-New Mexico also assists public entities, such as USFWS with the appropriate permits from NMDGF, and Native American Tribes with PDM, when requested. Coyotes, skunks, and opossum are not protected by NMDGF and are considered predatory animals; their damages to agricultural and rangeland resources are managed by NMDA, and WS-New Mexico, under the agreement, responds to requests for assistance. Landowners also have the right to protect their resources from unprotected predatory species without a permit.

WS-New Mexico's JPA with NMDGF and the agreement with NMDA establish a cooperative relationship between WS-New Mexico and NMDGF and NMDA, outline responsibilities and agreements for funding, and set forth objectives and goals for resolving wildlife damage conflicts in New Mexico. NMDGF, as the lead agency, may request assistance from WS-New Mexico for any species under their primary responsibility, with WS-New Mexico acting as their agent for PDM work. While WS-New Mexico is acting as an agent for NMDGF for IWDM work under state agency jurisdiction, NMDGF is the lead agency at all times. NMDGF is responsible for issuing any required permits for management actions and can specify the methods to be used. Recognizing that the wording of the JPA and agreements may change upon renewal, it is not expected that future conditions included in the agreements would have environmental relevance not already evaluated in this EA.

At other times, when not working as an agent for NMDGF, WS-New Mexico has authority under the Act of 1931 and subsequent amendments allowing for WS-New Mexico to enter into agreements with public and private entities. Therefore, WS-New Mexico can operate under federal authority as well as the authority of state law to work directly for cooperators.

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

1.8 HOW DOES WS-NEW MEXICO WORK WITH FEDERAL AGENCIES?

1.8.1 How does WS-New Mexico work with the USFS and BLM?

The USFS and the BLM manage federal lands under their jurisdiction for multiple uses, including wildlife habitat, livestock grazing, timber, wilderness, cultural resources, and recreation.

APHIS-WS coordinates with these land management agencies before performing PDM activities on lands under their jurisdiction through Annual Work Plans (AWPs) (See Section 3.11). The federal land management agencies USFS and BLM prepare land management plans per the National Forest Management Act (USFS) and FLPMA (BLM) that guide long-range management direction and include action constraints for protecting sensitive resources. At some time either between FY15 and FY19 or prior, WS-New Mexico has been requested to operate on some National Forests and BLM Districts. Current AWPs involve five national forests in New Mexico and four BLM districts for protection of livestock and human safety. All national forests and BLM Districts may request WS-New Mexico assistance with emergency work at any time.

For this EA, the USFS and BLM are cooperating agencies and have been involved with this EA to ensure consistency with their land management plans (WS-New Mexico does not currently have cooperative agreements with forests and districts in italics):

- *Apache NF*
- Carson NF
- Cibola NF
- Coronado NF
- Gila NF
- Lincoln NF

BLM has nine districts, each with a Resource Management Plan (RMP):

- *Farmington*
- *Rio Puerco*
- Socorro
- Las Cruces
- Roswell
- Carlsbad
- *Taos*

For WS-New Mexico, between FY15 and FY19, less than 9% of take of target predators and 34% of activities with predator species occur on Federal land (MIS 2019).

1.8.2 What MOU's does APHS-WS have with the USFS and BLM?

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

A. MOU with the Forest Service (2017):

The purpose of this MOU is to document the cooperation between the parties to (1) to identify responsibilities and foster a partnership in discharging the Federal obligation under the Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C. 426-426b), as amended, the Act of December 22, 1987 (101 Stat. 1329-1331, 7 U.S.C. 426c), Executive Order 13112, Forest Service Manual 2900 (Invasive Species Management), and the National Invasive Species Council Management Plan (2016-2018), for the management of indigenous, feral and non-native vertebrates causing damage on NFS lands; (2) to establish general guidelines to assist field personnel in carrying out their WDM responsibilities consistent with policies of the U.S. Forest Service and APHIS-WS; and (3) to strengthen the cooperative approach to WDM on NFS lands through exchange of information and mutual program support.

B. MOU with the BLM (2020):

The purpose of this MOU is: (1) to establish general guidelines to assist APHIS-WS field personnel in carrying out their WDM responsibilities consistent with the policies of the BLM and APHIS-WS; (2) to strengthen the cooperative approach to WDM on BLM-administered lands through exchange of information and mutual program support; (3) to identify responsibilities in compliance with the National Environmental Policy Act (NEPA) implementing guidelines of the respective agencies; (4) to foster a partnership in fulfilling the federal commitment under the Act of March 2, 1931 (46 Stat. 1468, 7 U.S.C. §§ 8351-8352), as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. § 8353), for the management of wild and feral vertebrates causing damage on BLM lands in accordance with the Federal Land Policy and Management Act of 1976 (FLPMA) 43 U.S.C. §§1701 *et seq*.

In addition to these MOUs, the USFS, BLM, and Association of Fish and Wildlife Agencies (AFWA) entered into an agreement in June 2006 (AFWA 2006). These policies and guidelines provide the framework for cooperation for fish and wildlife management in federal WAs. This agreement addresses the restrictions on certain actions in WAs, such as use of motorized equipment and pesticide use, with specific exceptions. The Policies and Guidelines specifically address wildlife damage control in Section 13. The 3 agencies agreed to use the "Minimum Requirement Decisions Process Outline" attachment to determine if the action is necessary to manage the area as wilderness and to determine the minimum requirements for the administration of the area for the purpose of the act. The Wilderness Act (Sec. 2(a)) defines the purpose of the act "…administered for the use and enjoyment of the American people is such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character…" (see Section 1.10.3 for Wilderness Act and Federal Land Management Policy Act (FLPMA) for wilderness study area management and relevant land management agency policy manuals).

The BLM incorporated the Policies and Guidelines agreement into affected BLM manuals (BLM Manual 6330 (BLM 2012a) and 6340 (BLM 2012b)). The USFS incorporated the Policies and Guidelines into FSM 2323.32 and FSH 2309.19 to be implemented "in a practical, reasonable, and uniform manner in all National Forest wilderness units" (United States Forest Service 2007).

PDM actions in wilderness areas are discussed further in Section 3.11.

1.8.3 How does WS-New Mexico work with the USFWS?

When WDM activities may affect federally listed threatened or endangered species, WS-New Mexico consults with the US Fish and Wildlife Service (USFWS) to ensure its program will not jeopardize the continued existence of the listed species. Under Section 7 of the ESA, Federal agencies must consult with the USFWS when any action the agency carries out, funds, or authorizes may affect a listed endangered or threatened species. WS-New Mexico prepared a Biological Assessment (BA) for all WDM activities in 2014 (WS 2014) which resulted in a concurrence letter issued December 2014 (USFWS 2014). WS-New Mexico closely follows operational measures outlined in its ESA consultation documents to minimize the risk of take of listed species (Section 2.4).

WS-New Mexico may also assist the USFWS in protecting ESA-listed species, when requested.

Minimization measures, reasonable and prudent measures, and terms and conditions included in the consultation documents are identified in Section 2.4 and analyses of the potential impacts of the WS-New Mexico program on threatened and endangered species is located in Section 3.6.

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

- APHIS-WS and the USFWS recognize that non-target migratory birds might incidentally be killed despite the implementation of all reasonable measures to minimize the likelihood of take during actions covered under depredation permits, depredation and control orders, and agricultural control and eradication actions.
- During NEPA compliance, APHIS-WS will evaluate the reasonable range of alternatives, assess and estimate impacts on migratory birds, monitor migratory birds with other collaborators (as funds allow), and consider impacts on target and non-target species and ways to minimize impacts.
- USFWS will provide APHIS-WS available migratory bird population data, reported take by non-APHIS-WS entities, and biological information as requested within a reasonable time frame.

1.8.4 How does WS-New Mexico work with the FAA and National Association of State Aviation Officials?

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

APHIS-WS MOU with the FAA (2103) and the NASAO (2006):

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

1.8.5 How does WS-New Mexico work with Tribes?

WS-New Mexico recognizes the rights of sovereign tribal nations, the unique legal relationship between each Tribe and the Federal Government, and the importance of strong partnerships with Native American communities. WS-New Mexico is committed to respecting tribal heritage and cultural values when planning and initiating wildlife damage management programs as requested by Tribal governments and/or residents or permittees. Timely and meaningful consultation and coordination with tribal governments, to the greatest extent practicable and permitted by law, are conducted consistent with Executive Order (EO) 13175 and APHIS-WS' plan implementing the executive order, including implementing the government-to-government relationship. WS-New Mexico offers early opportunities for formal government-to-government consultation on its proposed program to all Tribes in New Mexico, and has requested their involvement for this EA through direct invitations (2020) and agency draft EA review opportunities.

The APHIS Native American Working Group, created in response to EO 13175 and made up of management and support program personnel, advises APHIS-WS personnel nationwide how they can better serve Tribes, Intertribal committees, and related organizations, and helps coordinate APHIS' partnerships with Tribal governments. The APHIS-WS Tribal Liaison contact information is found at https://www.aphis.usda.gov/aphis/ourfocus/tribalrelations/sa_tribal_contact_us.

APHISDirective 1040.3, "Consultation with Elected Leaders of Federally Recognized Indian Tribes" (https://www.aphis.usda.gov/library/directives/pdf/aphis-1040-3.pdf) implements EO 13175 (Section 2.4.1.16). It directs APHIS 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. The Directive provides detailed definitions relevant to APHISand tribal government interactions and relationships, laws, and regulations, policy, and APHIS management responsibilities. The Directive states regarding interpretations of agency or Tribal policies: "Unless specific judicial rulings or Acts of Congress indicate otherwise, APHIS' policy and philosophy will not be construed as validating the authority of any Native American government over lands or other resources or non-tribal members."

No WS-New Mexico PDM activities are conducted on tribal lands without a specific request from the tribe. WS-New Mexico currently does not have any agreements with any tribes in New Mexico for PDM work. If a tribe requests WS-New Mexico assistance, WS-New Mexico will consult with the tribe regarding when, where, and how PDM actions and strategies may be conducted, and ensure that the action and strategy is approved. If PDM activities are requested on Indian Lands, the Tribal government and/or the Bureau of Indian Affairs have the authority to determine the methodology used. At the tribe's request, WS-New Mexico will report on any PDM activities taken on tribal lands, including lands within the reservation boundary but not currently owned by or managed by or for the tribe.

Federal agencies have trust responsibilities to federally-recognized tribes that other entities and governments do not, including government-to-government relationship, consultation, and coordination. PDM actions taken by non-Federal entities may not provide the participation in decision making regarding PDM activities that is provided by APHIS-WS as a federal agency.

The Native American Graves and Repatriation Act of 1990 (NAGPRA), and Senate Bill 61 (signed in 1992), requires, in part, that a federal agency that makes new and inadvertent discoveries of Native American cultural items, including human remains, funerary objects, sacred objects, and other objects possessing continuing cultural, traditional, or historical importance to tribes and Native Americans during its actions on federal, state or private lands shall notify tribes and return such items to lineal descendants or Indian Tribes (disposition) associated with such items. Since WS-New Mexico does not cause ground-disturbance during its PDM activities, it is highly unlikely that any such items would be disturbed during activities. However, some items may be on or near the surface and be found by WS-New Mexico field personnel, at which time work would stop in that area and NAGPRA processes would be implemented.

Table 1.2. WS-New Mexico Lethal Take by Land Class, FY 2015- FY 2019.

Land Class	% Total Predator Intentional Take by Land Class
Private/State	90.54%
BLM	7.95%
Forest Service	0.64%
County/City Land	0.28%
Other Public Land	0.0%
Military	0.25%
Tribal	0.34%

1.9 HOW DOES WS-NEW MEXICO COMPLY WITH NEPA?

For this EA, WS will proceed under the 1978 NEPA regulations and existing APHIS procedures since this EA was initiated prior to the September 14, 2020 NEPA revisions.

1.9.1 How does NEPA apply to WS-New Mexico's PDM activities

WS-New Mexico 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; and
- Including agencies and the public in their NEPA planning in support of informed decision-making.

Updates regarding WS-New Mexico implementation of predator damage management in New Mexico have prompted WS-New Mexico to initiate this new analysis. The analyses contained in this environmental assessment (EA) are based on information and data derived from APHIS-WS' Management Information System (MIS) database; data from the NMDA and NMDGF regarding species under their jurisdiction; published and, when available, peer-reviewed scientific documents (Chapter 4); interagency consultations; public involvement; and other relevant sources.

This EA describes the needs for resolving predator damage problems for which WS-New Mexico is typically requested to assist. The EA identifies the potential issues associated with reasonable alternative ways and levels of providing that assistance. It then evaluates the environmental consequences of the alternatives for WS-New Mexico involvement in PDM.

WS-New Mexico has made this EA available to the public, agencies, tribes and other interested or affected entities for review and comment prior to making and publishing the decision (either preparation of a Finding of No Significant Impact (FONSI) or a Notice of Intent to prepare an Environmental Impact Statement (EIS)). Public outreach notification methods for this 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, and notification in the legal section of the *Albuquerque Journal* newspaper. 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.

Wildlife damage management is a complex issue requiring coordination among state and federal agencies and the tribes. To facilitate planning, efficiently use agency expertise, and promote interagency coordination with meeting the needs for action (Section 1.11), WS-New Mexico is coordinating the preparation of this EA with cooperating and consulting partner agencies, including NMDGF, NMDA, FS, BLM and USFWS. WS-New Mexico also recognizes the sovereign rights of Native American tribes to manage wildlife on tribal properties, and has invited all federally recognized tribes in New Mexico to cooperate or participate in the development of this EA. WS-New Mexico is committed to coordinating with all applicable land and resource management agencies, including tribes, when PDM activities are requested.

1.9.2 How will this EA be used to Inform WS-New Mexico's decisions?

Although WS-New Mexico only conducts PDM when requested by a governmental, commercial, or private entity, as a federal agency, it is required to comply with NEPA for its activities. WS-New Mexico is the lead for APHIS-WS' PDM in New Mexico. WS-New Mexico has the technical expertise in management of damage caused by native predators and their activities. Cooperating agencies in the development of this EA are BLM, FS, USFWS, NMDGF, and NMDA. Each of the cooperating agencies are asked to review the draft document and provide input and direction to WS-New Mexico to ensure actions are in compliance with applicable federal and state regulations and policies, federal land management plans and joint MOUs, and cooperative agreements.

WS-New Mexico will use the analyses in this EA to help inform WS-New Mexico decision-making, including whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI); and whether or not to continue WS-New Mexico PDM activities and, if so, to determine how and to what degree such activities would be implemented.

WS-New Mexico has previously developed an EA that analyzed the environmental impacts of alternatives for reducing adverse predation impacts on agricultural and natural resources, property and HHS. The analysis included a review of PDM for coyotes, feral dogs, feral cats, red fox, gray fox, swift fox, kit fox, raccoons, bobcats, black bears, cougars, badgers, ringtails, long-tailed weasel, Virginia opossum, and striped, western spotted, hog-nosed and hooded skunks in New Mexico (WS 2006).

Since WS is developing this EA to re-evaluate activities described in the 2006 EA to address the need for action and the associated affected environment, the outcome of the Decision issued based on the analyses in this EA will supersede the analyses and Decision from the 2006PDM EA.

This EA does not include predatory birds or feral swine. Birds are included in a statewide bird damage management EA, *Bird Damage Management in New Mexico 2009* (WS 2009a), and feral swine were analyzed in a pending statewide EA, *Feral Swine Damage Management in New Mexico 2020.*

1.9.3 How does this EA relate to site-specific analysis and decisions using the 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. Although WS-New Mexico 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-New Mexico. Therefore, WS-New Mexico must be ready to provide assistance, on short notice anywhere in New Mexico to protect any resource or human/pet health or safety.

The APHIS-WS Decision Model (Section 2.3.1.2) is the site-specific procedure for individual actions conducted by WS-New Mexico 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 (Section 2.4), relevant laws and regulations, interagency agreements and memoranda of understanding, 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 New Mexico for which WS-New Mexico may be requested for assistance.

1.9.4 What is the geographic scope of this EA and in what areas will WS-New Mexico's actions occur?

The geographic scope of the actions and analyses in this EA is statewide. WS-New Mexico has decided that one EA analyzing potential operational impacts for the entire State of New Mexico 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-New Mexico 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. The proportion of PDM operations conducted on various land classes is found in Table 1.2.

Routinely, operational areas may include:

A. Private and State Property

Private and commercial property owners and/or managers of private property request WS-New Mexico for PDM assistance. WS-New Mexico work initiation documents may combine private vs state lands on the same agreement. Sometimes private landowners that are being affected by predators that reside in habitat located on adjacent public lands may request assistance. The adjacent property owner/manager may agree to allow PDM activities to occur to assist the affected landowner. More than 89% of the take associated with the species covered in this EA occurred on private and state lands. Private property includes areas in private ownership in urban, suburban, and rural areas, including agricultural lands, timberlands, pastures, residential complexes, subdivisions, and businesses.

B. Federal Property

Per the MOUs with the USFS and BLM, WS-New Mexico responds to permittee and agency requests for PDM for protection of livestock on federal grazing allotments, conflicts with resource damage, and threats to public health and safety.

WS-New Mexico coordinates with the agencies prior to the grazing/recreation seasons to identify needs, types of operations, and restrictions to operational areas, all of which is documented in an Annual Work Plan, and reports annually to the agencies on their activities (Section 1.8). This includes limited operations in areas with special designations, such as wilderness areas and wilderness study areas (Section 3.11).

WS-New Mexico may also respond to requests for assistance with human health and safety incidents on federal lands. Approximately 13% of WS-New Mexico activities occur on federal lands (Table 1.2). Coyotes are the primary species taken on BLM lands, and coyotes, bears, and cougars are the primary species taken on National Forest System lands. Coyote take on National Forest System lands is less than 1% and coyote take on BLM lands is approximately 9% of the total coyote take. Overall, approximately 10% of WS-New Mexico's total coyote take occurs on federal land.

C. Municipal Property

Activities are conducted on properties owned and/or managed by New Mexico municipalities when requested. Less than 1% of WS-New Mexico activities are conducted on county or municipal lands (Table 1.2).

D. Tribal Property

Tribal governments and landowners can request assistance from WS-New Mexico for PDM on lands under their authority and/or ownership. Predators have an important role in tribal culture and religious beliefs. The exact nature of this relationship and role varies among Tribes and individuals within Tribes. WS-New Mexico continues to work with tribes to address their needs through consultation for this EA, with policy, and in the field, as requested. Work conducted at the request of tribal governments is consistent with tribal decisions, values, and traditions as determined by the Tribal government through government-to-government consultations.

Native American tribes may choose to work with relevant cooperating agencies for meeting PDM needs, use WS-New Mexico's services, hire commercial control companies, or conduct their own work. Any participating Tribes would need to make their own decision regarding the management alternative they choose to implement. WS-New Mexico respects the rights of sovereign tribal governments, provides early opportunities for all federally-recognized tribes in New Mexico to participate in planning and developing PDM strategies affecting tribal interests and requests for assistance through consultations, cooperating agency status, and effective means of engagement through the government-to-government relationship consistent with USDA APHIS Directive 1040.3 and federal policy. Less than 1% of WS-New Mexico PDM activities occur on tribal lands.

E. Airports

Because habitat for small mammals that are prey for raptors and other predators may be found within fenced active airfields, these predators can become hazards to aircraft during are takeoffs and landings. WS-New Mexico receives requests for assistance and training from several airport authorities to address threats of aircraft strikes at some of the airports or airbases in New Mexico and may be requested for assistance at other airports in the future. WS-New Mexico currently provides services and/or training to several airports in New Mexico, including Albuquerque Sunport and Double Eagle II Airports in Albuquerque, Gallup Airport in Gallup, Angel Fire Airport in Angel Fire, Kirtland Air Force Base in Albuquerque, Cannon Air Force Base in Clovis, Holloman Air Force Base in Alamogordo, Deming Airport in Deming, Roswell International Airport in Roswell and Santa Fe Airport in Santa Fe.

1.9.5 For what period of time is this EA valid?

If WS-New Mexico determines that the analyses in this EA indicate that an EIS is not warranted (impacts are not significant per 40 CFR §1508.27; Section 1.10), this EA remains valid until WS-New Mexico 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-New Mexico monitors PDM activities conducted by its personnel and ensures that those activities and their impacts remain consistent with the activities and impacts analyzed in the EA and selected as part of the decision. Monitoring includes review of adopted mitigation measures and target and non-target take reported and associated impacts analyzed in the EA. Monitoring ensures that program effects are within the limits of evaluated/anticipated take in the selected alternative. Monitoring involves review of the EA for the issues evaluated in Chapter 3 to ensure that the activities and associated impacts have not changed substantially over time.

1.10 WHY IS WS-NEW MEXICO PREPARING AN EA RATER THAN AN EIS

1.10.1 What is the purpose of an EA

The primary purpose of an EA is to determine if impacts of the proposed action or alternatives might be significant, to determine if an EIS is appropriate (40 CFR 1508.9(a)(3) and 40 CFR 1501.4). This EA is prepared so that WS-New Mexico can make an informed decision on whether or not an EIS is required for the WS-New Mexico PDM activities included in this EA.

WS-New Mexico 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, and to evaluate and determine if there are any potentially significant impacts that may occur from the proposed action and alternatives. This EA also facilitates planning and interagency coordination, streamlines informed decision-making, and provides for timely and effective responses to requests for PDM assistance.

In this EA, WS-New Mexico conducts a thorough analysis of direct, indirect, and cumulative impacts associated with PDM assistance to requesting entities in managing predator damage and threats to resources, assets, and threats to human safety and health. WS-New Mexico addresses all anticipated issues and reasonable alternatives in this EA.

This EA includes thorough and comprehensive analyses of the impacts and effectiveness of five PDM alternatives including the no WS-New Mexico PDM Alternative (Section 2.3), 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-New Mexico activities and alternatives in detail, and provides rationale for not considering other alternatives and issues in detail.

WS-New Mexico involves the public in its EA processes by providing the public an opportunity to comment on pre-decisional EAs. WS-New Mexico encourages agency involvement through providing sister agencies the opportunity for cooperating and commenting agency status and the opportunity to comment on an internal interagency draft prior to public release. WS-New Mexico will provide a minimum 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, and/or alternatives.

Using the guidance provided in 40 CFR §1506.6 for public involvement, WS-New Mexico will clearly communicate to the public and interested parties the analyses of potential environmental impacts on the quality of the human environment. Public notification processes regarding the availability of the final NEPA document and decision will be identical to that used for the pre-decisional EA.

If WS-New Mexico 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-New Mexico 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)).

1.10.2 How will WS-New Mexico 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-New Mexico will review the impacts evaluated in Chapter 3 of this EA in two ways: the severity or magnitude of the impact on a resource and the context of the impact. For example, context may be considered when the resource is rare, vulnerable, not resilient, or readily changed long-term with even 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, not a determination of no adverse impact at all. Therefore, WS-New Mexico evaluates the impacts to resources and documents the predicted effects in the 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. If WS-New Mexico determines that the levels of impacts are not significant, then, per the 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 decision on whether to prepare a FONSI or an EIS. WS-New Mexico will determine the *degree* to which a factor applies or does not apply to the impacts documented in the EA.

The following discussion outlines how WS-New Mexico will use this EA and the criteria at 40 CFR §1508.27 to make the decision regarding whether an EA or an EIS is appropriate for the WS-New Mexico PDM program.

1.10.2.1 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 and/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 (for example, Section 1.12).

A relatively recent comment raised 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. This ecological issue and its cumulative impact analysis are evaluated in detail in Section 3.8.

Commenters also often express concern about the perception of the humaneness of lethal and non-lethal operational methods used by WS-New Mexico personnel. This issue is considered in detail using the best scientific and professional wildlife management and biology and veterinarian information available (Section 3.9.) APHIS-WS recognizes that people may readily disagree on the subjective analysis of the degree to which animals may feel pain and react to short-term and long-term stress associated with capture, immobilization, and euthanasia. This EA includes APHIS-WS Directives and other measures (Section 2.4) that are used routinely by WS-New Mexico personnel for minimizing the potential for pain and stress on animals in the field.

1.10.2.2 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 non-target species. Throughout the analyses in Chapter 3 of this EA, WS-New Mexico uses the best available data and information from wildlife agencies having jurisdiction by law (NMDGF, NMDA, 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 in Section 1.11.2.

Population and mortality data for many native target species (Section 3.5, Table E.1), such as raccoons, badgers, fox, coyotes, opossums, and skunks, are typically non-existent from any credible source, in or outside of New Mexico. WS-New Mexico recognizes that estimating wildlife populations over large areas can be extremely difficult, labor intensive, and expensive. NMDGF, 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, and/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 NMDGF when available, and peer-reviewed literature to assess potential impacts to predator and non-target wildlife species.

If population estimates are available, then the analyses in Section 3.5 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 NMDGF and the 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 Section 3.5 provide information for WS-New Mexico to determine if WS-New Mexico contribution to cumulative mortality from all sources would adversely affect population levels for each predator species considered.

1.10.2.3 Threatened or endangered species, unique geographic areas, cultural resources, and compliance with environmental laws

This EA also provides analyses and documentation related to threatened and endangered species, areas with special designations such as wilderness areas, cultural and historic resources, and compliance with other environmental laws, including state laws. This will be used to address the significance criteria at 40 CFR §1508.27(b)(3, 8, 9, and 10).

These issues are evaluated in the following sections:

- Impacts to threatened and endangered species: Section 3.6
- Impacts to unique geographic areas: Section 3.11
- Impacts to cultural and historic resources: Section 3.3
- Compliance with the Endangered Species Act: Section 3.6

1.10.2.4 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, for example (Section 3.2):

- Impacts to target species' populations, as each population has many sources of mortality, only one of which is take by WS-New Mexico;
- 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.

1.10.2.5 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 in Chapter 3:

- The potential for humans to ingest lead sourced from ammunition through water and game meat (Section 3.10.2.6);
- The potential for hazardous chemicals being spilled or leached into surface and groundwater, and being ingested by humans (Section 3.10.2.2);
- The risk of injury to WS-New Mexico employees during aerial shooting operations (Section 3.10.1.3); and
- The risk of injury to WS-New Mexico employees while handling hazardous chemicals, being exposed to diseased animals, and the risk of attack by captured animals (Sections 3.10.1, 3.10.3).

1.10.2.6 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. However, the efficacy of meeting the need for action (e.g., reducing predator damage or risks), is not considered to be environmental impact. Environmental effects are identified in Chapter 3 for each alternative (Sections 3.2, and 3.5 -3.13).

1.10.3 How do key statutes and executive orders apply to the WS-New Mexico program?

Appendix B lists the federal and state laws and executive orders relevant WS-New Mexico PDM activities. This section addresses New Mexico-specific application of highly relevant laws.

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)

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

Endangered Species Act (ESA)

WS-New Mexico has consulted with the USFWS regarding its current program. See Sections 2.4 and 3.6 for details on consultations and results.

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.

National Historic Preservation Act

WS-New Mexico has reviewed its program per this EA and continues to conclude that the program is not an "undertaking" as defined by NHPA and that consultation with the New Mexico Historical Preservation Division is not necessary.

WS-New Mexico works closely with the USFS and BLM on public lands to ensure there are no conflicts with cultural resources. Each of the methods described in the EA that may be used operationally and locally by WS-New Mexico does not cause major ground disturbance, does not cause any physical destruction or damage to property, does not cause any alterations of property, wildlife habitat, or landscapes, and does not involve the sale, lease, or transfer of ownership of any property.

In general, such methods also do not have the potential to introduce visual, atmospheric, or audible elements to areas in which they are used that could result in effects on the character or use of historic properties. Therefore, the methods that would be used by WS-New Mexico under the proposed action are not generally the types of activities that would have the potential to affect historic properties.

Although not foreseen, if WS-New Mexico is requested to assist with a PDM project that could potentially cause more than minor ground disturbance on public lands, then site-specific consultation as required by Section 106 of the NHPA would be conducted as necessary.

Consultation and Coordination with Indian Tribal Governments (EO 13175).

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

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

The USFWS has delegated permitting of aerial shooting to the state of New Mexico (NMDGF). NMDGF has determined that WS-New Mexico does not need to obtain a state permit from them because the APHIS-WS program has federal jurisdiction and authority. Other commercial, private, and lower governmental entities must obtain a permit from NMDGF for use of aerial operations for predator removals (Section 1.8).

Compliance with Executive Order 12898 "Environmental Justice"

WS-New Mexico personnel use damage management methods as selectively and environmentally conscientiously as possible. All chemicals used by APHIS-WS are regulated by the EPA through FIFRA, NMDA, DEA, by MOUs with federal land managing agencies, and by APHIS-WS Directives. Based on a risk assessment conducted in Section 3.10 of this EA, APHIS-WS concluded that when APHIS-WS program chemicals are used following label directions, they are highly selective to target individuals or populations, and such use has negligible impacts on the environment. The WS-New Mexico operational program properly disposes of any excess solid or hazardous waste and has been found to manage its chemicals appropriately (OIG Report 2015; Section 3.10.2). 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.

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-New Mexico has considered the impacts that alternatives analyzed in this EA might have on children. All WS-New Mexico predator damage management is conducted using only legally available and approved damage management methods where it is highly unlikely that children would be adversely affected. See Appendix A for a detailed description of all damage management methodologies included in the WS-New Mexico program and Section 3.10 for an analysis of their impacts.

The Wilderness Act

The Wilderness Act preserved management authority for fish and wildlife with the state for those species under state jurisdiction (Sec. 4(d)(8). Some portions of wilderness areas in New Mexico have historic grazing allotments and WS-New Mexico may be requested to conduct limited protection of livestock, as well as damage management and threats to human health and safety in compliance with federal and New Mexico laws. WS-New Mexico only provides assistance to requesting entities in designated wilderness areas when allowed under the provisions of the specific wilderness legislation and as specified in MOUs between APHIS-WS and the land management agencies.

The Wilderness Act does not prohibit WDM within designated wilderness. With certain exceptions, the Act prohibits using motorized equipment and motorized vehicles such as ATVs and landing of aircraft. The Forest Service and BLM may approve wildlife damage management in wilderness study areas and wilderness (FSM 2323 and BLM Manuals 6330 and 6340 respectively). WS-New Mexico works closely with the BLM and Forest Service in cooperatively implementing their respective interagency MOU for operations in wilderness and wilderness study areas (Section 3.11).

WS-New Mexico received a letter that grants approval to APHIS-WS to initiate control of predators and other types of depredatory animals, as well as other wildlife damage control activities within wilderness when certain conditions are met (USFS 2017). This letter does not grant approval for preventative control of any predator species in wilderness, the use of predacides in wilderness, or any of the prohibited uses outlined in Section 4(c) of the Wilderness Act.

See Section 3.11 for evaluation of impacts in specially-designated areas, including wilderness and wilderness study areas.

1.11 WHAT ARE THE NEEDS FOR THE WS-NEW MEXICO PDM PROGRAM?

1.11.1 What is the need for WS-New Mexico PDM 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 the US Department of Agriculture (Section 1.12.2), found that, despite cooperator implementation of non-lethal actions such as fencing and herding, a need exists for APHIS-WS' predator damage management activities. APHIS-WS management actions for predator damage was determined by these audits to be needed for protecting human safety and health; protection of crops and livestock; protection of other species, including threatened and endangered species, game and furbearer species, and recently reintroduced native species, as determined by the wildlife management agency; and protection of property and other assets.

As stated in Section 1.4.3, 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 non-lethal 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 that can lead to significant property damage and risks to passenger safety, or when a coyote acting aggressively in a residential area might be either habituated to humans or diseased. In cases where the affected entity is concerned with the threat of damage, the entity has often experienced damage in the past and it is reasonably foreseeable to assume 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 variable specific to the affected entity. The willingness of individuals to coexist with carnivores can be influenced by self-perceived knowledge about carnivores, the ability for an individual to have vocal input in management decisions, economic concerns, safety concerns, ecological factors, and spiritual or moral beliefs (Young et al. 2015). Just the presence of a wild animal may be considered threatening or a nuisance to people with low tolerance or inexperience with wild animals, or when the animals are viewed as cruel, aggressive, or frightening. Therefore, it is not possible to set a pre-determined threshold before a need for PDM is determined to exist.

WS-New Mexico is not required to assess the economic value of a particular loss or threat of loss before taking an PDM action, and WS-New Mexico responds regardless of the category of 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-New Mexico recognizes that increasing numbers of people moving into rural areas or living in urban areas with increasing populations of wildlife are often unfamiliar with wildlife and may become anxious with wildlife encounters, especially encounters with predators. Therefore, WS-New Mexico commonly provides technical assistance, including advice, training, and educational materials, to individuals, communities, and groups to better understand how to coexist with wildlife and reduce the potential for conflicts.

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

1.11.2 What is the need for PDM to protect livestock in New Mexico?

Predators are responsible for preying upon a wide variety of livestock, including cattle, sheep, goats, swine, horses, and poultry. Sheep, goats, cattle (especially calves), and poultry are highly susceptible to predation throughout the year (Henne 1975, Nass 1977, Tigner and Larson 1977, Nass 1980, O'Gara et al. 1983, Bodenchuk et al. 2002). For example, cattle, calves, sheep, and goats are especially vulnerable to predation during calving, lambing, and kidding seasons in the late winter and spring (Sacks et al. 1999, Bodenchuk et al. 2002, Shwiff and Bodenchuck 2004).

Not all producers suffer losses to predators; however, for those producers that do, those losses can be economically difficult and burdensome, and may cause small producers that are affected to experience years of negative profits (Fritts et al. 1992, Mack et al. 1992, Shelton 2004, Rashford et al 2010). Losses are not evenly distributed among producers, and may be concentrated on some properties where predator territories overlap livestock occurrence and predators learn to deviate from their natural prey base to domestic livestock as an alternative food source (Shelton and Wade 1979, Shelton 2004). Therefore, predation can disproportionately affect certain properties and further increase a single producer's economic burden (Nass 1977, Howard and Shaw 1978, Nass 1980, O'Gara et al. 1983, Bodenchuk et al. 2002, NMDGF 2006, 2012, Shelton 2004, Rashford et al. 2010). Shwiff and Bodenchuk (2004) state that profit margins in livestock production do not allow a 20% loss rate, and the absence of PDM, such losses would likely result in the loss of the livestock enterprise. Without effective methods of reducing predation rates such as those used by APHIS-WS, economic losses due to predation continue to increase (Nass 1977, Howard and Shaw 1978, Nass 1980, O'Gara et al. 1983, Bodenchuk et al. 2002).

1.11.2.1 What is the contribution of livestock to New Mexico's economy?

There are about 77.8 million acres in New Mexico, of which about 43.2 million (55%) are operating private farms and ranches. For 2016, cattle were the number two agricultural commodity in sales in New Mexico, comprising 25% of all the commodities, with total livestock making up 76% of all the agricultural commodity sales. All livestock commodity sales totaled more than $1.9 billion, out of the combined crops and livestock total of nearly $2.5 billion (NASS 2016). Of the livestock commodities, estimated cattle sales totaled $630,837,000, the second highest commodity in the state. The remaining livestock commodities included horses and mules ($24,219,000); hogs and pigs ($18,755,000); sheep and goats ($7,725,000); (NASS 2016).

Near the beginning of 2019, New Mexico livestock inventories included 1,480,000 cattle and calves, and 100,000 sheep and lambs (NASS 2018). In 2017, farmers and ranchers in New Mexico maintained 97,000 head of sheep and lambs, a reduction from 120,000 head in 2010 (NASS 2018).

Using data from 2012, the most recent and complete dataset available, New Mexico State University's Extension Service stated in a published report (Diemer, et al. 2014) that "…Agriculture alone accounted for $3.9 billion in sales at the farm/ranch level and an additional $2.1 billion in value-adding processing/distribution, marketing, financing, and supporting services[i]. Agriculture was responsible for a total of 41,961 jobs in New Mexico in 2012, including 26,924 jobs in production-related activities and an additional 15,037 jobs in processing/distribution, marketing, financing, and supporting activities. As the 3rd ranked sector in the New Mexico economy, agriculture accounts for approximately 7% of the state's GDP.

Successful PDM includes focusing on effective methods and strategies to prevent losses from occurring by protecting the livestock at risk. It is much easier to assess the level of damage or loss once it occurs and much harder to measure the value of what is being protected by implementing preventative PDM. One way to assess the value of what is being protected is to measure the quantity of the resource with the direct market value of those resources. Not all resource owners request assistance of WS-New Mexico. However, WS-New Mexico estimates that PDM activities provide resource protection for an average of $204,837,737 worth of cattle and calve resources per year between FY 15 and FY 19 (MIS 2020).

The dollar value of damage documented by WS-New Mexico that is caused by predators is often related to the number of requests for assistance received for a particular species. However, differences can be noted between predator species, primarily because larger species often cause much more damage with a higher value in one incident than species that are smaller. The monetary losses from livestock predation reflect losses that have occurred and that have been reported to or verified by WS-New Mexico, but is not reflective of all livestock losses occurring in New Mexico since not all livestock lost to predators are reported to WS-New Mexico.

1.11.2.2 What do studies say about the numbers of livestock losses due to predators?

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

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

- Losses in the absence of direct PDM activities have been estimated to include:
    - Adult sheep ranged from 1.4% to 8.4%, lambs ranged from 6.3% to 29.3% (Shwiff and Bodenchuk 2004);
    - Adult doe goat losses were 24% and kids 62% without PDM (Guthery 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 1979);
    - Adult sheep and lambs can range from 8.3% to 29.3%, respectively (Henne 1975, Munoz 1977, O'Gara et al. 1983);
    - Lambs could be as high as 22.3% (McConnell 1995 in: Houben et al. 2004).
- Losses with direct PDM activities in place:
    - Adult sheep 1.6%, lambs 6%, goats and kids 12%, and calves 0.8% (Bodenchuk et al. 2002);
    - Lambs 1% to 6% (Knowlton et al. 1999);
    - Lamb losses can be as low as 0.7% (Nass 1977, Tigner and Larson 1977, Howard and Shaw 1978, Wagner and Conover 1999, Houben et al. 2004);
    - Lamb loss proportion to coyote predation was reduced from 2.8% to less than 1% on grazing allotments in which coyotes were removed 3 to 6 months before summer sheep grazing (Wagner and Conover 1999).
    - Adult sheep loss about 2%, 4.68% of the lambs, 0.05% of adult cattle, and 0.89% of the calves produced in Oregon (DeCalesta (1978)

1.11.2.3 What are livestock losses to predators nationally?

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

NASS conducted a survey in 2014 to determine livestock losses to predators nationally. This survey found that sheep and lamb losses due to predators represented 28% of the total loss of sheep and 36.4 for lambs from all types of mortality, accounting for 194,395 animals killed (a decrease since 2009), valued at $32.5 million. Of these losses to predators, 89.8% of them occurred from known predator species, whereas 9.2% occurred from unknown species (NASS 2015; Table 1.3).

Table 1.3. The Percentage Of Total Losses Attributed To Specific Predator Species And The Associated Amount Of Damage In Terms Of Head Of Cattle-Calves (NASS 2011) And Sheep-Lambs (NASS 2015) And Dollars Lost For Each.

	% Total Predator Loss		Number of Head		Value ($)	
Predator Species	**Cattle/ Calves**	**Sheep/ Lambs**	**Cattle/ Calves**	**Sheep/ Lambs**	**Cattle/ Calves**	**Sheep/ Lambs**
Coyotes	53.1	60.5	116,700	135,600	48,185,000	10,707,000
Dogs	9.9	13.3	21,800	29,800	10,067,000	2,807,000
Cougars/ Bobcats	8.6	10.6	18,900	23,800	9,221,000	1,915,000
Bears	1.3	3.8	2,800	8,500	1,415,000	769,000
Other[1]	27.1	11.8	59,700	26,500	29,587,000	2,099,000

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

The losses reported above do not include the additional damage inflicted on 31,215 sheep and lambs injured but not killed, valued at $5.1 million. The combined losses occurred despite sheep operators increasing their utilization of non-lethal methods in 2014 (58% of sheep operations) as compared to 2004 (31.9%). Methods comprised of guard animals (63.9%), fencing (54.8%), shed lambing (34.4%) and night penning (33.7%)(NASS 2015). In 2004 (NASS 2005) sheep operators reported spending $9.8 million on non-lethal methods. Cattle operators spent $188.5 million on non-lethal 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.

1.11.2.4 Which predators cause the most predation on livestock?

Of the predators that kill livestock, coyotes are responsible for the highest percentage (Knowlton et al. 1999, Shelton 2004, NASS 2005, NASS 2006, NASS 2010, NASS 2011, NASS 2015). In a study of sheep predation on rangelands in Utah (Palmer et al. 2010), coyotes accounted for the majority of lamb losses at 67%, with fewer losses attributed to cougars (31%) and black bears (2%). Other predators that cause measurable predation on cattle, calves, sheep and lambs are black bear, cougar, red fox and feral or free-roaming dogs. While predation by black bears and cougars is not as frequent as coyote predation, the damage caused by these species can negatively impact producers (NASS 2005, 2010, 2015; 2016 MIS data).

Although, in general, cougar predation is lower than that of coyotes, cougars can occasionally be responsible for large sheep and lamb loss events, sometimes called "*surplus killing*." This occurs when a single predator, for unknown reasons, only consumes selected tissues or parts of many animals or the carcasses are not fed on at all (Shaw 1987).

Cougars or other predators may also frighten an entire flock of sheep as they attack, resulting in a mass stampede, which sometimes results in many animals suffocating as they pile up on top of each other in a confined area, such as along the bottom of a drainage or in corrals.

1.11.2.5 What are livestock losses to predators in New Mexico?

WS-New Mexico responds to requests from resource owners that had or are experiencing some type of conflict with a predator. Damage reported to WS-New Mexico, by resource owners, such as predation or injury to livestock, is recorded in the APHIS-WS MIS database as "reported" damage. If WS-New Mexico employees are able to verify that the damage occurred, it is recorded in MIS as "verified" damage, defined as resource or production losses examined by a WS-New Mexico employee during a site visit and determined to have been caused by a specific predator species. For more details on methods of field evaluation by WS-New Mexico personnel, see Section 2.3.1.3.

Predator damage and the associated estimated monetary values varies annually due to changes in the number of requests for assistance, the value of the resource being damaged, and fluctuation of both livestock and predator populations. The monetary losses from livestock predation reflect losses that have occurred and that have been reported to or verified by WS-New Mexico. However, these are not necessarily reflective of all livestock losses occurring in New Mexico since not all livestock lost to predators are reported to WS-New Mexico.

Between FY15 and FY19 WS-New Mexico received reported and verified predator livestock losses annually averaging 924 animals valued at more than $314,000 (Table 2). The predatory species involved were coyotes, cougars, feral dogs, bobcats, black bears, gray foxes, striped skunks, raccoons, and badgers. Annual average livestock losses from FY15 to FY19 included 503 adult sheep and lambs, 502 adult cattle and calves, 190 various poultry, 63 goats and 1 other livestock (Table 2). Of the $304,005 in annual average livestock losses by predators, coyotes were responsible for 93%, bobcats 3.1%, cougars 1.65%, and black bears 0.72%. The remaining four species were responsible for less than 2% of the value of losses. Many of the other predators in New Mexico covered by this EA can also kill or injure livestock, but WS did not record any losses associated with those predators between FY15 and FY19.

In 2009, NASS (2010) reported that predators killed 5,500 adult sheep and 3,700 lambs in New Mexico, with a valued of $660,000 and $241,000 respectively. Cattle and calf predation losses due to predators in New Mexico totaled 3,300 and 6,600 head, respectively, valued at more than $5.2 million in 2010 (NASS 2011). Of the predators identified as causing losses to cattle in 2010, cougars/bobcats, coyotes, wolves, dogs, and bears were responsible for about 44%, 26%, 2%, 2% and <1% of the losses, respectively (NASS 2011). Of the calf loss, coyotes, cougars/bobcats, dogs and bears were responsible for 65%, 16%, 6% and 1% of the losses, respectively (NASS 2011).

During requests for assistance received by WS, cooperators often report or WS verifies through site visits, damage associated with various predators in New Mexico. Between FY15 and FY19, New Mexico WS received reported and verified predator livestock losses annually averaging 925 animals valued at more than $314,000 (Table 2). The predatory species involved were coyotes, cougars, feral dogs, bobcats, black bears, gray foxes, Mexican gray wolves, striped skunks, raccoons, ringtails, and badgers.

A summary of the predator species responsible for loss of livestock in New Mexico as reported by NASS is in Table 1.4 and number and value by predator and type of livestock is summarized in Table 1.5.

Table 1.4. Percentage Total Predator Loss and Number of Head of Cattle, Calf, Sheep, and Lamb Losses Attributed to Predator Species in New Mexico (NASS 2015, 2011)[1].

Predator Species	% Cattle loss	% Calf loss	% Sheep loss	% Lamb loss
Coyotes	25.9	65.2	38.2	40.9
Cougars/ Bobcats[1]	44.3	16.4	< 1 / < 1	< 1 / 2.7
Bears	0.4	1.3	< 1	< 1
Dogs	1.7	6.3	53.8	44.5
Wolves	2.4	-	-	-
Other	3.4	3.6	8.0	4.7
Unknown	21.9	7.2	< 1	3.5
Total	3,300	6,600	2,194	2,659

1 For cattle and calves, loss to cougars and bobcats was combined (NASS 2011). However, for sheep and lambs, they were separated (NASS 2015).

Table 2. Annual average number of livestock killed or injured by predators in New Mexico from FY15–FY19 and associated loss value.

Livestock	Average	Loss Value
Cattle	133	$140,982
Goats	16.6	$5,778
Sheep	105	$23,521
Fowl	33	$3,579
Other Livestock	1	$2,701
Total	288.6	$176,563

*Livestock injured and killed by predators in New Mexico verified by WS, and the categories include adults and young. Fowl includes domestic chickens, ducks, guineas, turkeys, and peafowl. Other livestock includes horses, mules, and llamas. Dollar values for the resources are based on nationally calculated averages or are reported by the producer. Livestock Values in this table are rounded to the nearest dollar. (MIS 2020).

1.11.2.6 How many requests for assistance occur in New Mexico?

Requests for assistance are an indication of the level of need for PDM work to be conducted by WS-New Mexico, but these requests likely represent only a portion of the actual need. For example, Connolly (1992) determined that only a fraction of the total predation attributable to coyotes was reported to or verified by APHIS-WS nationally. Connolly (1992) also stated that, based on scientific studies and livestock loss surveys generated by NASS, APHIS-WS only confirms about 19% of the total adult sheep and 23% of the lambs actually killed by predators.

WS-New Mexico personnel record their responses to requests for assistance in the WS MIS database. Each response is recorded as a Work Task, documenting the species and resource(s) that are in conflict. A Work Task is defined as a single visit to a property or contact by WS-New Mexico personnel to provide technical assistance, to conduct a wildlife damage field evaluation/assessment/investigation, or to continue work on a PDM activity/project in progress. The number of work tasks serves as an index of the intensity of effort or responses by WS-New Mexico personnel to address incidents involving the particular species which are impacting particular resources. Reports of these conflicts do not represent the number of individual landowner requests for service, but rather the number of responses by WS-New Mexico for those types of resource/species combinations. This information can describe the frequency of responses to requests for assistance.

At the time of providing a response to an individual request for service, WS-New Mexico may provide a requester with information, demonstrations, recommendations for strategies that the landowner may implement (technical assistance), and/or direct assistance in which the WS-New Mexico employee takes direct action to address the predator situation. As an individual situation may involve one or more predators causing damage to more than on resource, the conflict data recorded for the field visit cannot be used to determine the number of unique requests for assistance for each predator and/or livestock animal.

The average number of conflicts WS-New Mexico recorded for the species in this EA is over 10,266 responses (Work Tasks) per year between 2015 and 2019 (MIS 2017). Out of the total number of responses, predator damage to livestock comprises 76.4%% or an average of 6,397 annual responses. Of all the resources in the livestock group, calves, adult cattle, lambs, and adult sheep are the resources most frequently in conflict with predators, at 57.96%, 7.84%, 20.84% and 4.94% respectively. Approximately 90% of the conflicts with livestock were associated with damage or threat of damage from coyotes, with other predators contributing a smaller proportion each (Table 1.7).

Table 1.7. Total Count of Work Tasks for PDM for Livestock by Predator Species Recorded by WS -New Mexico, FY 2015 – FY 2019 (MIS 2020)

Species	Livestock	Proportion of Work Tasks
Coyote	35,285	90%
Black Bear	288	<1%
Raccoon	17	<1%
Cougar	468	1.2%
Bobcat	2016	5%
Striped Skunk	32	<1%
Feral Dog	359	1%
Badger	17	<1%
Gray Fox	114	<1%
Total	39187	100%

1.11.2.7 How does WS-New Mexico cooperate with NMDGF in managing cougar and bear damage to livestock?

In New Mexico, the cougar is managed as a big game species by NMDGF and harvest is restricted; NMDGF issues depredation permits when needed per New Mexico regulations.

NMDGF has management authority for black bears and has decision responsibility over the take and disposition of black bears damaging resources in New Mexico, similar to the situation with cougars discussed above. WS-New Mexico and NMDGF have a Joint Powers Agreement (JPA) for WS-New Mexico to assist NMDGF in responding to some of these complaints. NMDGF uses commonly accepted methods for monitoring harvest, depredation take, and other mortality, such as road kills, to determine impact on the black bear population. Thus NMDGF is able to monitor take from all sources and maintain a viable population in accordance with management objectives.

A complaint filed with NMDGF can be for one or multiple cougars or bears that may be responsible for the damage of a particular resource or property. Therefore, the number of complaints recorded does not necessarily indicate how many predators were involved, but rather the frequency of damage occurrences in New Mexico during a calendar year. Property owners, who must report the take to NMDGF, may also take depredating animals.

Between 2015 and 2019 NMDGF responded to 1941 complaints for cougars and 735complaints for black bears. This number includes complaints for damage or threat to livestock, property, human health and safety, and all other complaints.

1.11.2.8 What proportion of WS-New Mexico livestock PDM occurs on public and private lands?

New Mexico encompasses 121,598 mi² in 33 Counties (Figure 1) and consists of 43% private lands, 17% BLM, 12% USFS, 12% State, 9% Tribal, and 7% other lands. From FY 2015 through FY 2019, New Mexico WS conducted PDM on active cooperative agreements for over 20 million acres. This represents about 30% of New Mexico's total acreage. The majority of property under agreement for PDM is privately owned (47%), followed by BLM (22%), State (11%), County/City (10%), USFS (9%), and other lands including tribal lands (1%). WS generally only conducts activities on a small portion of the land acres under a MOU, Work Initiation Document, or other comparable document.

In New Mexico, predator damage or threat of damage specific to livestock occur mostly on private/state land (74.7%), followed by USFW lands (10.28%), BLM lands (9.35%), and County or City lands (3.27%)(MIS 2020, Table). The primary livestock grazing use of these lands is for cow-calf production and production of range bands of sheep.

BLM lands in New Mexico tend to be highly "checker boarded" with private land, and work on one land class may actually benefit livestock on another land class, especially near the property lines. Because of the mobility and large home ranges of coyotes and other large predators, some PDM is conducted adjacent to private lands on BLM and FS grazing allotments in order to provide adequate and efficient livestock protection.

The need for PDM activities on public lands depends upon the type of livestock, time of year, and location where they are grazed. As sheep and lambs are smaller than cattle, sheep tend to be more susceptible to predation than cattle. Additionally, lambs are put on allotments shortly after birth when they are more vulnerable to predation by coyotes and other predators. Producers frequently report damage and request assistance from WS-New Mexico during the spring season when livestock are more susceptible to predation.

Table 1.9 summarizes livestock losses by land classification.

Table 1.9. Summary of the Average Annual Number of Livestock Lost Due to Predators by Land Class in New Mexico where WS-New Mexico Conducts PDM (FY2015-FY2019).

Land Class	Cattle	Sheep	Goats	Horses	Total
Private/State	287	295	72	1	655
USFS	40	15	0	0	55
BLM	24	66	1	0	91
County/City	0	1	1	0	1
Total	351	377	74	1	803

The primary predators of concern on federal land are coyotes (MIS 2017).

1.11.2.9 What diseases do predators transmit to livestock in New Mexico?

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

1.11.3 What is the need for PDM in New Mexico for protecting agriculture resources and property other than livestock?

1.11.3.1 Background

As discussed previously, predators within the scope of this EA in New Mexico cause conflicts with livestock, comprising more than 76.4% of WS-New Mexico's responses to conflicts (based on Work Tasks recorded). The remaining 14% of responses were for conflicts between predators and other agricultural resources (.7% of total responses), human health and safety (8.3%), natural resource protection (0.4%) and property damage (5.0%). Direct or indirect damage to other agricultural commodities include, fruit and nut crops, field crops, range and pasture, eggs, livestock feed, silage, and sod. Field crops are damaged by coyotes, bears, badgers, skunks, and raccoons. Fruit and nut crops, have also been damaged by coyotes, bears, foxes, and raccoons. Black bears are omnivores and farm and fruit crops can be attractive, readily-available, high calorie sources of food, especially in the fall. Bears often damage the fruit trees by breaking branches to access the fruit, which can be a total loss or significant loss in production.

Predators such as foxes and badgers can burrow in improved or planted pasture, inhibiting the use of planting and mowing equipment and damaging the equipment. Predators also damage buildings and structures (including homes, sheds, barns, coops, etc.), trying to gain access for food or other resources, and undermining the structure's foundation. Bears, coyotes, skunks, and badgers damage irrigation pipe systems. These and other predators burrow into dikes and dams, damaging barriers and liners. Skunks, raccoons, coyotes, and Virginia opossums destroy gardens, lawns, or turf farms. They live under homes, destroying insulation and other components and creating health concerns with feces.

Although damage to other agricultural resources and property has occurred and could continue to occur, damage or the threat of damage to those resources occurs less frequently in New Mexico compared to damage to livestock.

What Actions Does NMDGF Take to Address Property Damage Caused by Bears?

NMDGF has the authority under NMSA 17-2-7.2, 17-3-1 and 17-5-3 to conduct depredation complaints caused by black bears. NMDGF received 735 black bear complaints for the period from October 1, 2014 to July 17, 2019. Complaints that involve human safety, damage to private property or killing of livestock shall take priority over other activities. One standard response cannot be developed for all conflict situations with bears. The employee responding must always use discretion and experience to determine the appropriate course of action. The animal's behavior often will dictate how it is handled. The decision whether to destroy or to translocate bears is made using age, sex and behavior of the animal, the local environment and the events leading up to the situation.

The department provides advice and education to the general public to attempt to resolve conflicts with bears, first through simple precautions in as many instances as possible. Property damage by bears may be eliminated or mitigated by various means depending on the type of damage that is occurring. Chemical and noise repellents, hazing, and electric fencing may be effective methods to reduce damage depending on specific situations. Because bears are sensitive to electricity, electric fences may eliminate bear damage to beehives, orchards, livestock, domestic fowl, or other property. However, electric fences may be difficult and costly to install and maintain, or may be prohibited by local ordinances, particularly in residential areas. Electric fences may present some risk of starting wildfires under certain conditions. Bears are strong, agile climbers, and as a result, other types of fences may be ineffective at preventing damage from bears.

Under NMAC 19.30.2.8, a landowner or lessee is allowed to use lethal control to address immediate threats of damage to private property or human life related to a game animal or other quadruped, without obtaining a permit from the NMDGF. Complaints about black bears causing damage are often addressed by landowners, landowner agents, or the WS-New Mexico agent in participating counties and at the discretion of the landowner. The presence of a WS-New Mexico agent in any given county is dependent on that county providing partial financial support for a full- or part-time agent. These agents assist producers with advice or lethal control to address issues related to damage by bears and other wildlife species.

For predators, data collected from complaints may actually reflect annual changes in food availability rather than population abundance (e.g., Howe et al. 2010), landscape characteristics and land-use changes (e.g., Merkle et al. 2011), or regulatory changes (e.g., Howe et al. 2010). However, as black bear and human abundance and distribution increase, an increase in the level of human-black bear conflicts may be expected (Garshelis and Hristienko 2006). Harvest regulations involving season length and number of tags available may be modified to address situations where certain management units are experiencing property damage over several years. Concentrating hunting effort in these units, when necessary, may reduce actual damage from bears as well as the number of damage complaints.

1.11.4 What is the need in New Mexico for protection of human health and safety, and pets from predators?

1.11.4.1 What is the potential for risk to human and pet health and safety from predators?

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 due to the ready availability of food, water, and shelter inadvertently provided by residents. These habitat alterations may include landscaping vegetation, artificial pools, pet food, presence of pets (leashed or unleashed), garbage, piles of waste debris, and woodpiles, for example. Many people desire experiencing wildlife to the point of purchasing food specifically for feeding wildlife despite the fact that the NMDGF discourages this in New Mexico.

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 (Section 1.11.4.8), and mortality due to collisions with vehicles on roadways.

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

1.11.4.2 What is the extent of human-coyote interactions in New Mexico?

Although wildlife attacking people occurs rarely, the number of attacks appears to be on the increase, especially near human residential areas. Timm and Baker (2007) defined a single "attack" as an incident in which physical contact between one or more humans occurred at a single location at a point in time. Their database found 111 incidents (except for one) in California, occurring since the early 1970s, resulting in injuries to 136 individuals (87 adults and 49 children). An additional 62 incidents involved coyotes aggressively approaching or stalking adults or children, in which no physical contact occurred.

Human-coyote conflict in urban environments with overly bold and aggressive behavior toward people and pets is on the increase in the U.S. (Breck et. al. 2017). Breck et al. (2017) conducted a study in urban Colorado focusing on reactive coyote management and found that alone, reactive nonlethal hazing as conducted in their study was ineffective in reducing human-coyote activity overlap, although reactive lethal removal of problem individuals was effective. When bold and aggressive behavior toward people manifests in social groups, attempts at returning the behavior back through reactive hazing, such as in the study, is most likely ineffective as the problem typically evolves over time through learned experiences with people. If the reactive corrective stimuli doesn't cause pain, then it is not likely perceived as a threat, successful resolution in that case would be reactive lethal removal of the problem coyote(s). Breck et al. (2017) concluded that a successful urban community human-coyote conflict management plan would include primarily a proactive non-lethal component with a lethal component for problem individuals. Bonnell and Breck (2017) found in their Colorado urban environ hazing study that coyotes were less likely to respond to hazing if the hazer was accompanied with a dog, but that a community-level hazing program can be an effective short-term tool. They also state that "We emphasize that there is no reliable evidence (i.e., peer-reviewed research) showing community-level hazing or other forms of hazing will train a problem coyote out of severe conflict behavior." Which is, again, the reason that lethal removal must always be reserved as a response in an effective urban coyote management plan.

Timm et al. (2004) reported that coyotes attacking people have increased in California, and further study by Timm and Baker (2007) found the problem possibly increasing in other states, including at least 76 attack incidents from 18 states outside of California and 17 attacks in four Canadian provinces. The study found that urban sprawl of residential developments has reduced the amount of buffer habitat between wildlands and suburban communities. Additionally, recent reductions in coyote control efforts due to public concern may have led to increased attacks on people by allowing for a larger coyote population size near suburban areas and by lessening coyotes' fear of humans which is normally reinforced by lethal control methods (Timm et al. 2004). In addition, coyote attacks on pets are apparently beginning or are occurring in increasing numbers of suburban areas throughout North America (Timm and Baker 2007).

Timm and Baker (2007) find that conflicts with coyotes occur when the animal has become habituated to the residential area, learning to tolerate at a distance, then becoming more "tame" through positive reinforcement such as availability of food, including through intentional feeding. Most often, habituation and subsequent problems arise because people attracted the coyote to the area by giving it access to food. After emboldened coyotes have become accustomed to a being provided with food, the abrupt remove of the food source may result in increased aggression or attacks on pets, children, and adults (Timm et al. 2004). While coyote attacks on humans are very rare in New Mexico, NMDGF and WS-New Mexico receive many complaints from the public related to urban coyotes, many of which are due to misconceptions and fear of coyotes and not necessarily because of evidence of damage or attack (Table 1.10).

Recent and highly publicized coyote attacks have only heightened people's awareness of the potential threat of such encounters. In the Chicago metropolitan area, newspaper articles related to human-coyote conflicts have increased over twenty-fold since the 1990's (White and Gehrt 2009). In July 2015, four coyote attacks on children were reported in Irvine, California within a month (Heck 2015, CDFW 2015). While bites or deaths caused by coyotes are generally reported by the media as 'attacks', White and Gehrt (2009) found that some reports of coyote scratches or neighborhood sightings have been reported as 'attacks.'

There are many preventative, non-lethal measures that the public can take to reduce the likelihood of conflicts with coyotes, including feeding pets inside, removing brush and wood piles, installing motion-activated lights, and keeping a close eye on children and pets (CDFW 2015). Additionally, WS and NMDGF suggest that dogs be kept on a leash and dog-walkers be cautious of coyote dens in the spring, when coyote mothers are territorial and protective of their young. Should a threatening encounter occur, making loud noises, stomping feet, waving arms, and throwing rocks at the animal are advised in order to scare away the coyote and reinforce a negative association with humans.

When non-lethal methods are not effective or human health and safety is at imminent risk, lethal methods may be needed. Coyotes are classified as an unprotected furbearer by NMDGF in New Mexico and can be lethally removed year-round. However, methods for lethal take may be limited in urban areas pursuant to local ordinances or laws.

Timm et al. (2004) conducted a study on the best and most sustainable method to resolve issues with urban coyotes after several human-coyote conflicts were documented. The study concluded that the use of foothold traps to capture and euthanize a few coyotes is most effective (Timm et al. 2004). Prior to this study, traps were shown to be effective at removing coyotes from Glendale, California, shortly after a child was killed in his yard. City and county officials trapped 55 coyotes in an 80-day period from within one-half mile of the site of the attack, an unusually high number for such a small area (Howell 1982).

WS-New Mexico assists many urban residents concerned about a predator's apparent loss of fear for humans, damage threats, or attacks on their pets or themselves or others. During FY 2015-2019, WS-New Mexico responded to 978 conflicts (work tasks) with pets, 74.2% of which were related to coyotes, 15.3% to mountain lions, 4% to striped skunks, raccoons, 1.2% to gray fox, and 1.5% to bobcats. The remaining conflicts were regarding a variety of non-predator wildlife(MIS 2020).

Table 1.10. Coyote Complaints Recorded WS-New Mexico 2015-2019.

	2015	2016	2017	2018	2019
Pets	110	215	136	142	123

Human Health/ Safety	96	319	259	376	233

NMDGF does not track coyote complaints because they do not manage coyotes.

1.11.4.3 What is the extent of human-black bear interactions in New Mexico?

At least 63 people have been killed by non-captive black bears between 1900 and 2009, mostly in Alaska and Canada (49 fatal encounters), with 14 fatal encounters in the lower 48 states. In 38% of the incidents, the presence of food or garbage probably influenced the bear being in the location. Most fatal predatory incidents involved adults or sub-adult male bears, indicating the female bears with young are not the most dangerous bears (Herrero et al. 2011).

Of the six attacks by black bears on people in New Mexico from 1990-2009, at least two may have been predatory (Herrero and Fleck 1990). There was one black bear caused human fatality near Mora, New Mexico in 2001. In this case, WS provided assistance to capture the offending animal as requested by NMDGF. In June 2016, an adult female black bear attacked a woman as she was jogging in Valle Caldera National Preserve. State law requires any wild animal that any wild animal that attacks or bites a human be euthanized and tested for rabies. NMDGF officers captured the bear near the area where the attack occurred. Although predator attacks on people are rare, New Mexico-WS could receive additional requests for assistance if such attacks occur.

NMDGF is responsible for responding to situations where black bear are considered dangerous to people, and has entered into a Joint Powers Agreement with WS-New Mexico for receiving assistance where necessary (Section 1.8). WS-New Mexico provided 5 responses for conflicts regarding potentially dangerous interactions with bears for the years FY2015 to 2019 (MIS 2020). All of these responses (as measured by Work Tasks) were related to bears that were a threat to human health and/or safety.

1.11.4.4 What are NMGDF's objectives and strategies related to bear-human and pet health and safety management?

NMDGF, the agency with jurisdiction for bear management in New Mexico, has determined that a bear exhibiting the following behavior patterns may be considered a human safety hazard (NMDGF 2012):

1. Aggressive behavior:
   a. An animal is known or suspected to have caused a human injury;
   b. An animal aggressively approaches humans forcing the human to give ground;
   c. Any overt action by an animal that would cause a reasonable person to fear for their or someone else's safety (i.e. entering an inhabited residence regardless of attractant); or
   d. An animal displays predatory behaviors towards humans (stalking behavior, moves to intercept, etc.).
2. Unacceptable behavior:
   a. Intentionally approaching close to a human after the animal knows the human has seen it, even if the human did not have to take evasive or aggressive action to drive the animal off;

b. An animal that is not cornered, knows humans are aware of its presence, and fails to retreat given appropriate stimulus (after a human takes some action, such as yelling, waving arms, throwing objects at it or uses some other method of hazing);
c. The animal continues to disturb, raid, or investigate humans or frequents high human-use areas (e.g. fails to respond to aversive conditioning or has been previously tagged);
d. The animal causes property damage or causes multiple "nuisance" reports;
e. An animal is staying or lingering in the vicinity of a school or other area where children are congregated, especially during hours when children are present; or
f. An animal remaining in a residential area (neighborhood yards) and is eating pet food or pets (including chickens or goats).

Characteristics of residential areas often limit the ability to capture and remove bears that are a safety threat, nuisance, or causing damage. The presence of pets, children, and private properties make some methods used to capture or haze bears impractical. Discharging a firearm or other weapon is usually prohibited by law within city limits or by ordinance within residential areas. As a result, most conflicts in residential areas are resolved through advice from the department and actions taken by affected homeowners. In situations related to human safety or considerable damage within residential areas, culvert traps may be used by NMDGF in an attempt to capture the bear causing problems. Culvert traps or box-type traps are safe for use in areas where pets and people may frequent. However, the capture efficiency of these traps is limited, especially if food is readily available, so, in some circumstances, problem bears cannot be removed and residents must become educated on how to reduce or prevent the problems.

Table 1.11. Black Bear Complaints Recorded by New Mexico Game and Fish FY2015-FY2019.

FY	Livestock and Poultry	Human Health and Safety	Property and Pets	Other	Total
15	24	56	81	7	168
16	28	45	54	3	130
17	42	91	71	15	219
18	45	66	45	14	170
19	11	21	11	5	48
Total	150	279	262	44	735

1.11.4.5 What is the extent of human-cougar interactions in New-Mexico?

Potentially aggressive or dangerous cougar behaviors relative to human health and safety include charging, snarling, or loss of wariness of humans. Although rare, cougar attacks on humans in the western United States and British Columbia have increased in the last two decades (Beier 1992, Fitzhugh et al. 2003), primarily due to increased cougar populations, reduced hunting, and increased human use of cougar habitats (Beier 1992). For example, since California's Wildlife Protection Act of 1990 gave mountain lions special status in the state resulting in a prohibition on regulated hunting, there have been three fatal attacks and twelve non-fatal attacks in California between 1986 and 2014 (CDFW 2014;

https://www.wildlife.ca.gov/Conservation/Mammals/Mountain-Lion/Attacks). Fitzhugh et al. (2003) report there were 16 fatal and 92 non-fatal attacks on humans since 1890 in the United States and Canada. Of those attacks, seven fatal and 38 non-fatal attacks have occurred since 1991.

Cougar attacks on humans in New Mexico are extremely rare. Since 1970 there have been two recorded attacks both resulting in fatalities. In January 1974 an 8-year-old boy was killed by a cougar in Arroyo Seco, NM, and in June 2008 a 55-year-old man was killed near his home in Pinos Altos, NM. In this second case, NM WS provided assistance in capturing two cougars believed to have been involved in the attack.

From 2015 through 2019, NMDGF received 191 complaints related to damage or human safety. NM WS recorded 160 cougar conflicts associated with human safety and another 150 conflicts associated with pets.

1.11.4.6 What are NMDGF and WS-New Mexico responses to cougar threats?

Table 1.12. Cougar Complaints Recorded by WS-New Mexico 2012-2019.

	Wildlife Services		New Mexico Game and Fish		
FY	**Human Health & Safety**	**Pets**	**Human Health & Safety**	**Pets and Property**	**Total**
15	8	14	7	9	38
16	75	14	10	6	105
17	47	40	16	7	110
18	17	27	15	4	63
19	13	55	7	1	76
Total	160	150	55	27	392

1.11.4.7 What is NMDGF's policy regarding relocation of offending bears and cougars?

The success of relocating problem animals is often dependent on the age and sex of the relocated animal, as relocated bears may return to their original location or create similar problems in their new location (Rogers 1986). One standard response cannot be developed for all conflict situations with bears and cougars The decision whether to destroy or to translocate bears and cougars is made using age, sex and behavior of the animal, the local environment and the events leading up to the situation (NMDGF Guidelines for Responding to Bear and Cougar Conflicts 2012).

Bear: Department staff shall consider management goals, circumstances and the following prior to deciding to kill the offending animal:

- Bears that exhibit aggressive or unacceptable behavior shall not be considered for translocation and shall be killed. Bears displaying aggressive behaviors may be killed on-site provided the staff s actions do not threaten public safety.
- Female bears, particularly females with cubs, should generally be treated with more leniency than male bears
- Yearling bears and older bears without ear tag evidence of prior offending record

should be aversely conditioned on site as much as possible. Consider the following if not feasible for social or technical reasons:

- o Trap and release yearlings within the zone captured;
- o Bears trapped and relocated in same zone should be hazed aggressively;
- o Relocation into a different zone may be considered when releasing into the same zone is impractical.

Cougar: Cougars displaying aggressive or unacceptable behavior shall be killed. Practicality, safety and the on-site situation will determine whether the cougar killed on or off-site. Cougar behavior and the potential for conflicts with humans remain the guiding principles for Department action. Department staff may implement aggressive aversive conditioning where aggressive or unacceptable behaviors have not been observed. The Department may actively attempt to control cougars at high densities near residential areas.

1.11.4.8 What is the potential for disease transmission to humans and pets?

Diseases of wildlife, livestock, pets, and humans can be caused by viral, bacterial, or parasitic pathogen species. Zoonoses (i.e., wildlife diseases transmissible to people) are a major concern of cooperators when requesting assistance with managing threats from mammals. Pathogen transmission occurs through direct contact between infected and uninfected hosts, including host contact with a pathogen-contaminated environment or food product. Indirect transmission of pathogens, such as through an intermediate host or vector species such as mosquitos and biting flies, is another possible transmission pathway. Once a pathogen transmits to a new host species, such as livestock or pets, secondary cases of infection to the rest of the herd or humans can occur. Pets and livestock often encounter and interact with wild mammals, which can increase the opportunity of transmission of pathogens to humans. Diseases of wildlife, livestock, pets, and humans can be caused by viral, bacterial, or parasitic pathogen species. WS-New Mexico 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 neither 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-New Mexico, 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 New Mexico, not all of these pathogens have documented detections in New Mexico predator populations. WS-New Mexico currently conducts minimal sampling for diseases that can be transmitted to humans and pets in New Mexico, as part of the WS-National Wildlife Disease Program. However, WS-New Mexico remains available to assist NMDGF or the New Mexico Department of 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 the daytime 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 New Mexico, skunks and bats have been the historic reservoirs for rabies. Recently, foxes in southwest New Mexico counties have also been found to carry the rabies virus. This fox rabies strain has the potential to spread to new areas in the future. 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. 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 2016). 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).

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 working outdoors or in agriculture have a higher risk of developing leptospirosis (WHO 2019). Currently, WS-New Mexico 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 parasite causes little or no clinical disease in those natural host species, it can cause serious or fatal disease in humans and domestic animals. Raccoon roundworm is transmitted through eggs shed in feces. When raccoons use human structures for shelter, feces can build up in attics, roofs, and yards, increasing the odds that human 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 and coyotes, causing fur loss and thickened crusting on the skin. Mange is transmitted to other animals and to 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 ringworm (*Tinea* spp.,) a contagious fungal disease contracted through direct interactions with an infected person, animal, or soil; pasteurella; salmonella; cat scratch disease; and numerous parasitic diseases, including roundworms; tapeworms; and toxoplasma. 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 2012). In 1994, five Florida children were hospitalized with encephalitis that was associated with cat scratch fever (AVMA 2012). 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 2012).

Domestic and feral cats are also vectors of toxoplasmosis, through birds, and rodents and other mammals, which can infect humans and other wildlife through contact with cat feces and oocysts in the soil (Torrey and Yolken 2013). The oocysts can also enter water supplies, and persist in soil for up to 18 months (Dumètre and Dardé 2003). Toxoplasmosis can be transmitted to humans and cause miscarriages, still-births, microcephaly, mental retardation, and blindness. Although cats are only infected once before gaining immunity, the huge number of outdoor cats in the US is sufficient to maintain a large volume of oocysts in the environment. Reducing the number of feral and free-ranging cats is an important step in prevention (TWS 2014 http://wildlife.org/wp-content/uploads/2014/05/28-Feral-Free-Ranging-Cats.pdf). Cats are also a vector for rabies and plague as well as another 27 diseases (https://www.adn.com/voices/commentary/2016/05/25/alaska-is-no-place-for-feral-cat-colonies/).

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 WS-New Mexico is participating in the National Surveillance Plan by collecting blood samples from mammals, including predator species.

1.11.4.9 What work is needed to protect air operations from terrestrial predators at New Mexico airports?

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

The civil and military aviation communities have acknowledged that the threat to human health and safety from aircraft collisions with wildlife is increasing (Dolbeer 2000, Dolbeer 2001, Dolbeer 2009). Collisions between aircraft and wildlife are a concern throughout the world because wildlife strikes threaten passenger safety (Thorpe 1998), result in lost revenue, and repairs to aircraft can be costly (Linnell et al. 1996, Robinson 1996, Thorpe 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 2018, there were 4,363reported aircraft strikes involving 46 species of terrestrial mammals in the United States (Dolbeer et al. 2019). The number of mammal strikes actually occurring is likely to be greater even though strike reporting at General Aviation airports has increased 169% from 2010 to 2018. 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, porcupines, rabbits, and skunks (Dolbeer et al. 2019). Of the reports of terrestrial mammals struck by aircraft, 39% were carnivores (primarily coyotes), causing over $4 million in damages (Dolbeer et al. 2019). Aircraft striking coyotes have resulted in 16,793 hours of aircraft downtime and nearly $4 million in damages to aircraft in the United States since 1990 (Dolbeer et al. 2019). Aircraft strikes involving dogs have caused over $406,335 in damage in the United States since 1990 (Dolbeer et al. 2019).

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 2018 occurred at night, with 88% occurring during the landing roll or the takeoff run (Dolbeer et al. 2019).

From 1990 to 2019, aircraft strikes associated with predators have included 17 coyotes, 2 feral dogs, and 1 feral cat in New Mexico, according to reports filed with the Federal Aviation Administration (FAA) (FAA database 2020). Airports in New Mexico have requested assistance with managing threats to human safety and damage to property associated with predators present inside the area of operations of airports and receiving training in addressing their problems. The infrequency of aircraft strikes 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 New Mexico given that a potential strike could lead to the loss of human life and considerable damage to property.

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

WS-New Mexico provides part-time assistance to airports in New Mexico. For predator species considered in this EA, WS-New Mexico provided responses to conflicts at five airports, of which 84% of taken species were coyotes or skunks (MIS 2020).

1.11.5 What is the need for WS-New Mexico assistance to NMDGF and the USFWS for natural resource protection?

1.11.5.1 Background

Predation is one of many mortality factors that influences wildlife populations. Predators often play critical roles in the composition, distribution, and function of wildlife populations in ecosystems (Section 3.8). Normally, predation by native predators on native prey species is part of the function of a healthy ecosystem, and the health of a predator population is integrally linked to health of its prey base. However, high predation rates, especially on prey populations with few individuals and/or under resource constraints that are cumulatively impacted by human-induced environmental changes (habitat loss, recovery from extirpation, disease caused by concentration, etc.), can reduce the size and sustainability of populations, especially if they have low reproductive rates. The relationships of predators and prey are discussed in detail in Section 3.8.

Revenue derived from recreation and hunting, especially recreation related to wildlife and the outdoors, is increasingly important to the economy of New Mexico. In 2013, New Mexico's Department of Game and Fish (NMDGF) commissioned a study of fishing, hunting and trapping to estimate county-level and statewide activity and to determine the contribution that fishing, hunting, and trapping activity make to the state's economy. Hunters spend more than $342 million on hunting related activities. And, the state has 1,600 trappers who spend more than 72,000 days trapping and spend $3.5 million on trapping related activities (Southwick 2014).

NMDGF is charged with managing resident wildlife and is responsible for the maintenance of game populations for the benefit of the people of the State of New Mexico. NMDGF has identified that, under some circumstances, predators can cause additive constraints on the ability of some sensitive or vulnerable game species to reproduce and have healthy populations. When identified by the agency as necessary and appropriate, NMDGF may request WS-New Mexico, as well as other non-departmental personnel for assistance to protect species under their jurisdiction, with WS-New Mexico assisting NMDGF with technical and operational support.

NMDGF is fully responsible for determining if and when PDM actions are appropriate for protection of species under its jurisdiction, considering management objectives, reproduction rates and survival, sources of mortality, habitat quality and diversity, genetic limitations, and invasive species impacts.

These game species are managed according to management rules prepared by NMDGF:

- Bighorn sheep (NMDGF 19.31.17);
- Elk (NMDGF 19.31.14);
- Deer (NMDGF 19.31.13);
- Antelope (NMDGF 19.31.15).

These rules provide management actions for ensuring sustainable populations in New Mexico. Habitat management is under the jurisdiction of the appropriate state and federal land management agencies such as the USFS or BLM, often in coordination with NMDGF, as well as private landowners.

1.11.5.2 What is the potential effect of predation on ungulate populations in New Mexico?

Under certain conditions, predators considered in this EA, primarily black bears, coyotes and cougars, can have an adverse impact on deer, elk, bighorn sheep, and pronghorn antelope populations, and this predation is of concern during periods when the population is vulnerable, such as fawning, calving, and lambing (Pimlott 1970, USFWS 1978, Hamlin et al. 1984, Neff et al. 1985, Shaw 1981,).

The determination of the effect of predation on deer and elk is challenging and complex, with some studies in the western United States concluding that predators can have a major effect on deer populations, while other studies have found that predators have little effect. Differences in deer and predator densities, species of predator, weather, disease, human harvest, and whether the prey population is at habitat carrying capacity all influence the viability of wildlife populations.

Connolly (1978) reviewed 68 studies of predation on wild ungulate populations and concluded that in 31 cases, predation by coyotes had an influence on white-tailed deer, mule deer, pronghorn antelope, and bighorn sheep populations. Hamlin et al. (1984) observed that a minimum of 90% summer mortality of deer 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. Other authors also observed that coyotes were responsible for the majority of deer fawn mortality during the first few weeks of life (Knowlton 1964, White 1967). One study in the central Sierra Nevada in California found that predation was the largest cause of deer fawn loss, resulting in the death of 50% of all fawns during the first 12 months of life. In this instance, cougars were the main predator, with coyotes accounting for 27% of predation (Neal 1990). Teer et al. (1991) concluded from work conducted at the Welder Wildlife Refuge, Texas, that coyotes take a large portion of the fawns each year during the first few weeks of life. Another Texas study (Beasom 1974) found that predators were responsible for 74% and 61% of the fawn mortality for two consecutive years. Garner (1976), Garner et al. (1976), and Bartush (1978) found annual losses of deer fawns in Oklahoma to be about 88%, with coyotes responsible for about 88% to 97% of the mortality. Trainer et al. (1981) reported that heavy mortality of mule deer fawns during early summer and late fall and winter in the Steens Mountains in Oregon, primarily from coyote predation, was limiting the ability of the population to maintain or increase population levels.

Predation was found to be the leading cause of pronghorn antelope fawn loss, accounting for 91% of the mortalities that occurred during a 1981-82 study in southeastern Oregon (Trainer et al. 1983), with coyotes comprising 60% of that mortality. In addition, a coyote reduction 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 fawns from 4 fawns/100 does in 1984 to 34, 71, and 84 fawns/100 does in 1985, 1986, and 1987, respectively (Willis et al. 1993).

Other authors observed that coyotes were responsible for the majority of fawn mortality during the first few weeks of life (Knowlton 1964, White 1967). Reductions of local coyote and other predator populations have been shown to result in increasing fawn survival of white-tailed deer (Guthery and Beasom 1978, Stout 1982, Knowlton and Stoddart 1992) and pronghorn antelope (Arrington and Edwards 1951, Smith et al. 1986).

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, increasing pronghorn survival and abundance, but removal does not affect mule deer populations. Hurley et al. (2011) could not detect a strong effect of cougar or coyote removal on mule deer population trends in southeastern Idaho. A low correlation was found with the previous year's cougar removal and severity of the winter, with winter precipitation apparently the primary factor for mule deer population growth. Coyote removal increased neonate fawn survival may occur only under particular conditions of prey densities and weather conditions, and increased survival did not contribute to population growth. Even with increased mule deer survival and fawn ratios, the authors were unable to demonstrate significant changes in population trend with cougar removal.

NMDGF has the singular authority to manage game ungulate populations in New Mexico and, therefore, the authority to set its management goals objectives, and actions. The information contained in NMDGF's management rules is the most useful available for meeting their goals and objectives. WS-New Mexico may assist in meeting the agency's goals and objectives only when requested by NMDGF.

1.11.5.3 What are NMDGF management objectives related to predation of big game species?

Because of increasing evidence that black bear and coyote predation can limit some ungulate populations, local short-term management of predators under proper conditions can be an important tool in meeting specific big game management objectives. Factors such as predator densities, alternate prey densities, weather conditions, ungulate densities and vulnerability can influence survival and maintenance of young in a population. Based on research and experience, NMDGF has determined that, on a case-by-case basis, PDM may be an important tool for meeting their species management objectives. The decision to manage wildlife populations using PDM is solely a decision that is made by NMDGF as the jurisdictional wildlife management agency in New Mexico. NMDGF may request PDM assistance from WS-New Mexico, and WS-New Mexico considers all requests for providing assistance to NMDGF in meeting their wildlife management.

1.11.5.4 How do coyotes affect big game species?

Coyotes are ecological generalists; they can adapt to many different environments and diets. Even among ecological generalists, many wildlife biologists characterize coyotes as having a unique resilience to change. In fact, the habitat changes that have occurred over the last two hundred years have generally favored the species. Coyotes have been known to predate on several big game species, and have shown to limit some of these populations.

While mule deer do suffer from coyote predation, Hurley et. Al. (2010) found that coyote predation was related to lagomorph abundance, and the implementation of coyote control did not have an influence on early winter fawn recruitment.

Unlike mule deer, antelope and bighorn sheep populations can be susceptible to coyote predation (Pimlott 1970, Bartush 1978, Trainer 1983, Hamlin et al 1984, Neff et all 1985, Shaw 1977).

However, the primary predator for bighorn sheep are cougars, followed by bobcats and coyotes. NMDGF implements administrative take of cougars in bighorn sheep territory to manage such predation. Jones (1949) found coyote predation to be the main limiting factor in Texas pronghorns. Implementing coyote control has been shown to result in large increases in population size annually, and among pronghorn fawns (Neff et al 1985, Neff and Woolsey 1979, Smith et al 1986). In Arizona, implementing coyote management resulted in herd numbers increasing from 115 to 350 in just three years (Neff et al 1985).

1.11.5.5 What is the potential impact of black bear and cougar predation on New Mexico deer and elk populations?

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

Throughout the western United States, deer and elk are the staple food of cougars. Numerous studies have found deer to be the primary food item of cougars even when other ungulate species such as elk, bighorn sheep, or pronghorn were present (Robinette et al. 1959, Anderson 1983, Ackerman et al. 1984, Cashman et al. 1992, Beier and Barrett 1993, Logan et al. 1996). However, in many of these studies, ungulates other than deer were not available in significant numbers. Although a variety of other species, including small mammals and birds, may be eaten, cougars do not persist in areas without ungulate prey.

Cougars in northeastern Oregon consumed (in order of decreasing frequency): mule deer, Rocky Mountain elk, porcupine, snowshoe hare, and deer mice (Maser and Rohweder 1983). Winter foods for cougars in Oregon’s Cascade Range were principally black-tailed deer and porcupine (Toweill and Maser 1985). Another Oregon study indicated deer, elk, and porcupine were the most common winter food items (Toweill and Meslow 1977). In some cases there is a difference in prey selection based on sex, age, and reproductive status of cougars (Anderson and Lindzey 2003). In northeastern Oregon, Nowak (1999) found adult females killed more mule deer (65%) than elk (35%) and tended to select mule deer fawns, older adult mule deer females, and calf elk over other sex and age classes of available prey. Pierce et al. (2000b) also concluded that age and sex of prey were more important in cougar prey selection process than was body condition of the prey. The number of prey consumed by an individual cougar varies with a number of factors, such as the cougar's sex, age, size, and reproductive status, as well as weather conditions (kills spoil more rapidly in warm temperatures), competition with other predators such as black bear, and scavenging by other species such as birds and coyotes (Iriarte et al. 1990).

1.11.5.6 How does cougar and black bear predation affect deer and elk populations in New Mexico?

Historic records indicate elk in New Mexico (Rocky Mountain elk (*Cervus elaphus nelsonii*) were numerous and widely distributed in New Mexico prior to arrival of settlers. During the latter half of the 19th century ‘market hunting’ and human encroachment on elk range took a heavy toll on New Mexico’s elk populations. Market hunters killed thousands of elk for meat, hides, and antlers.

Cougar predation has been implicated in low elk calf survival and resultant elk population declines. In southeast Washington, cougar predation accounted for more than half the known elk calf mortality (Myers et al. 1999) and end-of-winter cow ratios averaged 21:100. Cougars were found to impact calf survival in two Idaho study areas with low ratios of calf:100 cows, responsible for 38% of known calf mortalities in the Lochsa River study area and 36% in the Clearwater River study area (P. Zager, Idaho Department of Fish and Game, pers. comm.; bears were also heavy predators on elk calves).

A four-year study was conducted, evaluating the role of predation and nutrition in limiting productivity of the elk population in northern New Mexico. The study found that there was low calf recruitment despite adequate condition and nutrition of adult females in the study area and suggested that substantial black bear predation was limiting population productivity. Results from the study suggest that productivity could be increased by implementing a spring black bear harvest strategy, targeting hunting or removal efforts near calving areas (Quintana 2016).

Cougar predation also impacts mule deer populations, although it is difficult to determine due to the 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, cougar 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 cougar predation of adult mule deer as the leading cause of mortality, accounting for 33% of all known mortality (Matthews 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 cougar 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.

Sorensen (2015) found that in north-central New Mexico, mountain lion predation accounted for 60% of all known mortalities to mule deer. Sorensen's results suggest that predation was a greater factor than nutrition on limiting adult female mule deer survival and population growth rates via fawn recruitment.

A study conducted at the Valles Caldera National Preserve (VCNP) in north-central New Mexico found that predation accounted for 94.8% of the known deaths of elk calves. Black bears (*Ursus americanus*) were the highest source of predation (47.3%, $n = 26$) and overall mortality (40.6%). Coyotes (*Canis latrans*) were the second highest source of predation (41.8%, $n = 23$) and overall mortality (35.9%). Therefore, the study concluded that predation of elk calves is likely additive and causing suppressed recruitment rates in the elk population on the VCNP (Bernal 2013).

1.11.5.7 How does cougar predation impact bighorn sheep populations in the West?

Wehausen (1996) reported several instances where cougar predation on bighorn sheep populations reduced population growth rates, resulting in the cessation of the bighorn sheep restoration program into new habitat. Kamler et al. (2002) suggested cougar predation was responsible for the decline in bighorn sheep populations in most areas of Arizona; these declines were most likely linked to overall declines in mule deer populations which resulted in cougar taking bighorn sheep as alternate prey. Rominger et al. (2004) similarly reported that cougars limited expansion of a transplanted population of bighorn sheep in New Mexico. Hayes et al. (2000) proposed that cougar predation on bighorn sheep may be impeding recovery of a federally-listed endangered bighorn sheep population in the Pennisular Ranges of California.

1.11.5.8 How does cougar predation impact New Mexico's bighorn sheep populations?
In New Mexico Rocky Mountain bighorn sheep are preyed upon by mountain lions, coyotes (*Canis latrans*), bobcats (*Lynx rufus*), and golden eagles (*Aquila chrysaetos*) (Hass 1995). Lion populations that primarily prey on deer and elk are able to prey-switch to bighorn sheep. If bighorn sheep populations are at carrying capacity, such as in the alpine habitats, predation is thought to be compensatory (the mortality would occur due to some other cause if not predation) rather than additive (the mortality would be additive to base-line mortality) and has not been documented to have an effect on a population level. However, if populations are small and below carrying capacity, as in 2 of the low-elevation Rocky Mountain bighorn sheep populations, mountain lion predation can become additive mortality and profoundly influence bighorn sheep population dynamics (Wehausen 1996, Hayes et al. 2000, Rominger and Weisenberger 2000). Although mountain lion predation is the primary cause of mortality for desert bighorn sheep in New Mexico (Rominger et al. 2001), no mountain lion predation has been documented on more than 85 radio-collared Rocky Mountain bighorn sheep in alpine ranges. In the 3 low-elevation Rocky Mountain bighorn sheep ranges mountain lions are the primary predator (NMDGF files). Between 1997 and 2002, 15 of 50 radio-collared Rocky Mountain bighorn sheep were killed by mountain lions in the 3 low-elevation populations (NMDGF 2005).

1.11.6 What is the need for WS-New Mexico's assistance with disease surveillance?

The increasing connectedness of our world and the increasing use intensity of our landscape amplify the potential for spillover of emerging and re-emerging pathogens in wildlife, livestock, pets, and humans. Some pathogens that circulate in wildlife are known to pose threats to livestock, pet, and human health. Threats include both mortality and morbidity, which can manifest in reduced individual growth rate, reduced fecundity, or reduced product yield. An active wildlife disease program provides WS-New Mexico and cooperators with valuable information on what wildlife species are being exposed to what pathogens and an index on the level of exposure. Additionally, WS-New Mexico's disease program allows for better communication and collaboration with our partners and quicker response time to potential disease outbreaks due to trained personnel solely dedicated to wildlife disease issues.

Detecting changes in the wildlife species exposed to pathogens and/or the level of exposure within a species indicates a change in the pathogen, host, and environment triad. This information is crucial to making disease mitigation and response decisions.

Because WS-New Mexico has access to many animals either while still alive or shortly after death as an inherent component of its program, it is often requested to opportunistically collect blood and tissue samples for the new APHIS-WS National Wildlife Disease Surveillance and Emergency Response Program as an additional part of its field operations. These samples are used to test for diseases such as a plague titer from mammalian blood (primarily from coyotes). Requests for samples have increased substantially, especially because of the new APHIS-WS program. Blood samples for plague have helped the New Mexico Department of Health identify plague "hot spots" within New Mexico, which has assisted county health departments provide public notification regarding the risk of plague contact in these areas. WS-New Mexico does not kill animals for this purpose; all samples are collected as a by-product of normal operations.

Disease surveillance and monitoring as a component of existing PDM activities reduces cost by eliminating a redundancy of effort in capturing predators to obtain samples. Further, under this opportunistic sampling method, only those predators captured as part of PDM activities are sampled for pathogens, thus eliminating the additive wildlife mortality that would be incurred if the PDM and wildlife disease programs were separate. Additionally, by removing individuals, PDM activities reduce the number of potential disease hosts, which may contribute to pathogen control.

WS-New Mexico has also collected tissue or blood samples for several other diseases in the last several years at the request of concerned citizens and cooperating agencies because of concern with health risks to people and pets. WS-New Mexico expects this trend to continue in the future as urban development expands and the risk of disease transmission to humans continues to increase.

Without the WS-New Mexico cooperation, it would be very difficult for agencies to collect large numbers of fresh samples from around the state.

1.12 WHAT IS THE EFFECTIVENESS OF THE NATIONAL APHIS-WS PROGRAM?

1.12.1 What are the considerations for evaluating program effectiveness?

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

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

To maximize effectiveness, field personnel must be able to consistently apply the APHIS-WS Decision Model (Section 2.3.1.2) to assess the damage problem, determine the most advantageous methods or actions, and implement the strategic management actions expeditiously, conscientiously, ethically, and humanely to address the problem and minimize harm to non-target animals, people, property, and the environment. Wildlife management professionals recognize that the most effective approach to resolving any wildlife damage problem is to use an adaptive integrated approach, which may call for the strategic use of several management methods simultaneously or sequentially (Courchamp et al. 2003, Scasta et al 2017).

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

The ability of an animal population to sustain a certain level of removal and to eventually return to pre-management levels eventually does not mean management strategies were not effective for addressing the particular event, but that periodic lethal and/or non-lethal management actions taken during a critical time of the year in specific places may be necessary in specific circumstances. The return of local populations to pre-management levels also demonstrates that the species can tolerate localized removals while having minimal impacts on the species' population (Sections 3.5, 3.7, and 3.8).

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

One of WS-New Mexico's objectives is to ensure that all PDM actions cumulatively would not cause adverse effects on statewide target predator populations, or on populations of non-target species (Sections 3.5, 3.6 and 3.7). Therefore, WS-New Mexico policy is not to cause population-wide or even localized long-term adverse impacts to the target species' populations (unless to meet NMDGF management objectives), or any adverse impacts to populations of native non-target 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.

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

1.12.2 How has the US government evaluated the effectiveness of APHIS-WS PDM activities?

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

1.12.2.1 2015 Office of the Inspector General report for program effectiveness

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

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

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

For the audit, OIG representatives:

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

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

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

The audit found that operations involving field personnel and aerial shooting 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 wildlife damage management 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."

The audit concluded that APHIS-WS was generally in compliance with all applicable laws. Of almost 30,000 entries in the MIS, 98% were correct with discrepancies of 2% identified, including both under- and over-reporting of take. APHIS-WS is committed to and actively addressing OIG recommendations intended to further reduce discrepancies.

Based on the interviews, the OIG concluded:

> "As one property owner put it, "WS [field specialists] are an absolute necessity for our business. The number of sheep they save is huge and we cannot function without

> them…WS specialists are professional and good at what they do." In support of this same point, a State game official we interviewed explained that WS provides help for wildlife and is run efficiently. A State agricultural official we interviewed characterized the collaboration of State and Federal programs to manage control of predators and protect domestic livestock and wildlife as 'seamless.' "

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

1.12.2.2 2001 Government Accountability Office report to Congress.

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

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

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

The report summary states:

> "Although no estimates are available of the total costs of damages attributable to them, some wildlife can pose significant threats to Americans and their property and can cause costly damage and loss. Mammals and birds damage crops, forestry seedlings, and aquaculture products each year, at a cost of hundreds of millions of dollars. Livestock is vulnerable as well. In fiscal year 2000, predators (primarily coyotes) killed nearly half a million livestock – mostly lambs and calves – valued at about $70 million. Some predators also prey on big game animals, game birds, and other wildlife, including endangered species…
>
> "Wildlife can attack and injure people, sometimes fatally, and can harbor diseases, such as rabies and West Nile virus, that threaten human health…We identified no independent assessments of the cost and benefits associated with Wildlife Services' program. The only available studies were conducted by the program or with the involvement of program staff. However, these studies were peer reviewed prior to publication in professional journals. The most comprehensive study, published in 1994, concluded that Wildlife Services' current program, which uses all practical methods (both lethal and

nonlethal) of control and prevention, was the most cost effective of the program alternatives evaluated. Other studies, focused on specific program activities, have shown that program benefits exceed costs by ratios ranging from 3:1 to 27:1 [depending on the types of costs considered].

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

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

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

1.12.2.3 Conclusion

Two recent detailed and extensive government audits of the APHIS-WS PDM program, one requested by Congress and one conducted by the USDA Office of Inspector General, found that the need exists for PDM on public and private lands using both lethal and non-lethal 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 both desired and effective in meeting the needs.

1.12.3 What is the efficacy of PDM for protection of livestock and sensitive species?

1.12.3.1 Background

Berger (2006) states that predator control is one of the oldest, most globally widespread forms of wildlife management, and that, in the 17 western states, 87% of federal funding for livestock protection involves larger predators, mostly coyotes. For sensitive wildlife species, even if human-caused habitat changes are the ultimate causes of population decline, predation may be the near-term causes of extirpation or extinction when the population is already otherwise under stress (fMosnier et al. 2008).

Studies of effectiveness at reducing livestock depredation often inappropriately mix broad-scale studies at state-wide levels with local, ranch-scale studies (for example, Harper et al. 2008, Poudyal et al. 2016), and studies involving seasonal livestock grazing (where livestock may be within an animal's home range for part of the year) and year-round livestock grazing (Blejwas et al. 2002).

WS-New Mexico PDM works at reducing livestock losses at the producer/cooperator level. Any livestock protection strategy must involve a partnership between the producers and WS-New Mexico PDM personnel to tailor methods to effectively address specific damage situations. A large proportion of WS-New Mexico PDM work involves requests for assistance in addressing coyote depredation on livestock (Sections 1.11.2 and 3.5). Commenters on other APHIS-WS PDM EAs also focus heavily on concerns with coyote depredation work. Routinely, removing individual predators such as raccoons, badgers, and foxes takes care of the problem, especially if the cooperator also partners with WS-New Mexico to address the conditions causing the problems. Coyote depredation, however, may be a recurrent problem, especially in areas where livestock lambing and calving overlaps with coyote territories and movements, and new coyotes replace offending coyotes. The high degree of selectivity of lethal and capture methods used by WS-New Mexico for all PDM activities involving predators included in this EA is discussed in Section 1.12., indicating a high degree of effectiveness in focusing on the offending animal, and their humaneness is discussed in Section 3.9. Therefore, this discussion will focus primarily on the effectiveness of WS-New Mexico PDM lethal and non-lethal methods regarding large predator depredations on livestock, with some recent papers regarding the effectiveness of lethal and non-lethal PDM methods on wolf depredation included because of the degree of similarities in social and depredation patterns between coyotes and wolves, as well as cougar depredation.

Effective coyote removal depends on the nature of the problem, presence or absence of historical patterns, relative size of the area, season of year, timing of depredations or anticipated depredations, and efficacy, selectivity, and efficiency of methods used (Knowlton et al. 1999). Linnell et al. (1999) address the potential effectiveness of focusing predator control efforts on "problem individuals" rather than populations as a whole. The authors define a problem individual within a species that is adaptable, territorial, complex, long-lived, and exhibits individuality through behavior changes is defined as one that kills more livestock than other individuals, especially in a situation where all individuals have livestock with their home range.

Considering the effectiveness of methods or combinations of methods should optimize the degree of intensive management relative to the biological importance of individual predators in the population, since each method typically works for a limited period of time as new animals replace those removed, and management methods should be used during the season or period having the greatest potential for conflicts between predators and humans. The primary factors that should be considered when developing an PDM strategy include the biological efficiency, the economic efficiency, and its ability to increase and assuage human tolerance to damage. The success of a management technique often must be measured by the tolerance of humans to predators, their presence, and resulting damage, which is a social and psychological construct, not a predator control and ecology issue (Shivik 2006; Section 1.4.3).

1.12.3.2 Coyote population and social dynamics related to livestock predation and management.

Since the Knowlton and Stoddart (1983) study was published, researchers and PDM practitioners agree that, at a minimum, the territorial alpha pair is the basic unit of coyote, as well as wolf, populations.

Few North American predators show greater adaptability in the face of exploitation than the coyote. Recent studies indicate that livestock located within or near coyote territories, especially during the temporal overlap of livestock calving/lambing and coyote pupping seasons, may experience a higher level of predation. Studies have found that coyote livestock depredation is almost exclusively caused by the alpha breeding pair (Knowlton et al. 1999, Gese et al. 1996, Sacks et al. 1999b, Blejwas et al. 2002, Jaeger 2004). Within a pack, only the alpha pair breed 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 and transient animals in a pack either stay in the pack without reproducing, die, or disperse (Knowlton et al. 1999). Therefore, population size and the territories themselves tend to remain relatively stable over time.

Selective removal of the alpha breeding pair shortly after the first depredation occurs so that any replacement pair does not have time to breed before the calving/lambing season concludes may be highly effective. However, selectivity for the alpha pair within their territory may be difficult because the alpha animals know their territory well, and new objects or human activity may also be well known, tracked, and avoided. Methods, including trapping and use of M-44s, may be less effective at directly selecting for individual alpha animals because it is not possible to know which animals make up the alpha pair without either DNA samples taken from saliva left on depredated animals or identifying when the depredation ceases during the lambing/calving season that year or the next (Jaeger 2004, Mitchell et al. 2004). Gantz and Knowlton (2005) suggest that late winter aerial shooting of coyotes living at high mountain elevations in close proximity to the grazing allotments in need of depredation relief would possibly include the territorial coyotes apt to be present the following summer and, therefore, reduce the likelihood that the territories would be repopulated by breeding coyotes the following spring.

Sterilizing the alpha pair to keep them from reproducing while maintaining their territory may be effective if the alpha pair can be identified and live captured (Till 1992, Mitchell et al. 2004). Killing the pups of the alpha breeding pair in the den may be the most selective method, as the presence of pups needing sustenance appears to strongly influence depredation by breeding pairs and only the breeding alpha pair has pups (Blejwas et al. 2002, Jaeger 2004, Mitchell et al. 2004). Ground or aerial shooting at or near the den can often be highly selective for the alpha animals. Succeeding in removing the alpha pair or their pups reduces depredation until another breeding pair with pups becomes established in the territory and if that breeding pair decides to begin livestock depredation. The time period before depredation begins again may range from days to many months, if not the following spring, depending on the situation and when the animals are removed (Blejwas et al. 2002, Jaeger 2004).

However, coyote depredation rates also appear to be influenced by livestock husbandry and management practices, breed and age of livestock, environmental factors, coyote biology and pack behavior, and the type and intensity of depredation management programs (Knowlton et al. 1999). Studies have shown that removal of what appear to be the "problem individuals" (corrective removal) even without knowing their status within the pack, and preventive removal prior to the livestock lambing/calving season, may also be effective at the ranch/farm level (for example, Wagner and Conover 1999).

1.12.3.3 Effectiveness of PDM methods for preventing coyote depredations.

Authors have discussed the effectiveness and selectivity of various methods commonly used by producers and/or PDM field personnel (Table 1.13). For capture and removal methods, effectiveness and selectivity also depends highly on the skill, experience, and expertise of the user.

Table 1.13. Effectiveness of Coyote Depredation Reduction Methods (adapted from Mitchell et al. 2004, Jaeger 2004, Shivik 2006, Shivik et al. 2014)

Non-lethal Methods (more effective when directly interactive with the coyote)		
Method	**Advantages**	**Disadvantages**
Fencing	May be nearly 100% effective if constructed correctly (high, and cannot dig under)	Only effective in small areas where livestock can be enclosed and watched; high construction and maintenance costs
Birthing sheds, lighting corrals at night	May be effective with sufficient human presence	Only effective in small areas where livestock can be enclosed and watched; high construction and maintenance costs
Herders	May be effective with unpredictable and constant human presence	Human-intensive; only effective if stock are not widely dispersed in areas with sufficient cover for predators
Guard animals (dogs, llamas, donkeys)	May be effective on small and medium sized ranches (Gehring et al 2010) or with unpredictable and constant human presence, and if well trained (Gehring et al 2011)	Only effective if stock are not widely dispersed in areas with sufficient cover for predators; can be expensive and time consuming to properly train/ensure they will be effective (Gehring et al 2011): may be killed by predators; may attack pets if in recreation area; some may begin to kill livestock; wolves may befriend guard dogs
Physical harassment (paintball with capsicum powder, rubber bullets, beanbag rounds, harassing dogs)	May be effective with unpredictable and constant human presence; address individual animals causing conflict at the time of conflict or potential conflict	Some ammunition may be limited to use by law enforcement; some ammunition, such as rubber bullets, may harm animals; harassment may have to be repeated if animals become habituated
Aversion (lithium chloride)	May be affective for short time, if the animal can tie it directly to the presence of livestock	Not effective if in baits, because animal does not associate the aversion with the livestock attacked; must be maintained; animals may habituate
Shock collars attached through snares	Still in testing stage	Expensive; must be attached to depredating animal through a snare or capture, and activated when the animal is near livestock

Electronic guard strobe light/alarm sound	Needs collared animals to activate the mechanism so that the harassment is directly associated with the activities, rather than random activation	Animals may habituate rapidly to random activation, especially if the animal does not associate the alarm with their presence; not currently commercially available
Sterilization	May be effective if sterilize alpha breeding pair that maintain territory without pups in areas where livestock is seasonal	May be difficult to identify alpha breeding pair unless at the den; may be expensive and labor intensive if alpha pair not identified
Lethal Methods (more effective when selective for target species and offending individuals; may be important tool for a successful reintroduction of a large predator because of the option for removing them when they cause conflict; improves trust of cooperators in effectiveness)		
Capture and lethal devices (traps, snares, M-44s)	Highly selective for species when used with appropriate baits, sets, and equipment	May not be as selective for targeting individual coyotes; younger, beta, transient coyotes substantially more vulnerable than alpha coyotes in territory
Aerial shooting	Highly selective for species, indication of pre-season effectiveness under some circumstances	May not be as selective for targeting individual coyotes; younger, beta, transient coyotes substantially more vulnerable than alpha coyotes in territory; unable to know if alpha coyote unless associated with a den
Sodium nitrate canisters (denning)	Highly selective for targeted alpha breeding pair to reduce depredation; reduces need to kill other adult coyotes that may not be offenders	May have problems with negative public perception
Coyote calling/ground shooting	Highly selective for species, possibly for individuals; calling may be used to lead field personnel to the den	May not target individual offending animals unless occurring at or near the time of depredation or animals are associated with a den; may also involve beta animals, especially helper animals at the den

1.12.3.4 Relationship of hunting and cougar depredation

A recent paper by Teichman et al. (2016) studies long-term data sets regarding age and sex of cougars taken during hunting seasons and those taken on depredation in western Canada. They found correlations between human encroachment into cougar habitat increasing the potential for depredation, and that young cougars were more likely to occur in areas used by people than other age classes. Dispersing juveniles were more likely to cause conflict with humans when traveling through fragmented habitats and high-risk areas including areas of human habitation, roads, and ranches, where juveniles, especially males, may attack livestock. The authors found correlations with human hunting tending to take larger adult animals rather than smaller juveniles (trophy hunting), which may increase immigration of dispersing juveniles from neighboring areas. They found that high hunting-related mortality in the same or preceding time period was positively associated with cougar-human conflict, especially with young males, as hunters typically target larger adults. Hunting can disrupt social structures leading to increased juvenile immigration and result in younger age structure in the population. They concluded that juvenile male cougars appeared more susceptible to conflict if hunted more intensively. The data also suggested that similar to other carnivores, cougar populations can persist in regions with high human densities as long as human hunting pressure is low. The authors recommend that targeting individuals causing the conflict may be an effective way to address human conflicts with large carnivores and caution against the use of hunting as a tool for managing conflict with larger predators.

1.12.3.5 Conclusions

Most authors recognize that more research is needed regarding coyote ecology and biology related to social dynamics and use of livestock and natural prey, and costs, benefits, and disadvantages (Knowlton et al. 1999, Blejwas et al. 2002, Mitchell et al. 2004).

Because of inherent population dynamics of large predators, including immigration/emigration, recruitment, territoriality, social dynamics, and inherent behavioral and learning adaptability, as well as differences in livestock management methods and changing circumstances, PDM for livestock and sensitive species protection will by definition be short-term and necessarily repeated as needed (Knowlton et al. 1999, Goodrich and Buskirk 2002, Mosnier et al. 2008). Targeting the individual(s) causing the conflicts is a demonstrated way to address specific conflict situations. APHIS-WS NWRC is constantly working to develop and test new lethal and non-lethal methods for predators. APHIS-WS and WS-New Mexico field personnel are highly experienced and trained in use and deployment of methods to increase effectiveness and selectivity (Sections 3.7 and 3.9).

WS-New Mexico is consistently requested to assist with depredation and damage involving many different large predators, including coyotes, wolves, bears, and cougars. The targeted PDM methods and applications, both lethal and non-lethal, have been shown to effectively assist cooperators with losses and damage, improving the economic viability of individual operations.

1.12.4 Are field studies on effectiveness of lethal PDM for livestock protection sufficient for informed decision making.

Frontiers in Ecology and the Environment recently published a paper proposing that the lethal removal of predators be suspended until scientific studies proving the effectiveness of lethal methods are conducted using the same standards as those used in controlled laboratory settings for biomedical research.

APHIS-WS agrees that predation damage management tools and techniques must be based on rigorous, scientifically-sound principles. But, field and laboratory studies require different study designs. APHIS-WS scientists do not agree with Treves et al.'s assessment that existing research is flawed and believe it would be irresponsible to limit the ability of wildlife managers and trained experts to effectively resolve predator damage issues.

APHIS-WS experts are dedicated to gathering information, testing new ideas and methods and using experiments (versus observational studies) as much as possible. NWRC's scientists at its 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 findings are published in peer-reviewed literature.

APHIS-WS realizes there are many variables (such as weather, varying habitat quality, movement of wildlife, etc.) that cannot be controlled and assumptions that must be made when trying to answer complex ecological questions in field settings. Working in a field environment is not the same as working in a biomedical laboratory. NWRC scientists address and acknowledge these variabilities using well-established and recognized field study designs, such as the switch-back and paired block designs. Treves et al.'s critique of at least two APHIS-WS studies did not accurately interpret or represent the studies' designs or results and raises questions regarding additional misrepresentations and errors in the paper.

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

APHIS-WS bases its management recommendations and decisions on the use of a structured decision model known as integrated wildlife damage management (IWDM). APHIS-WS, as well as state and federal agencies and independent professionals, resolve wildlife damage issues by applying this model. The model encourages the use of a variety of methods and tools (both non-lethal and lethal) for resolving wildlife conflicts. These methods are continuously reviewed, tested, and evaluated to ensure they are safe, effective, environmentally-sound, and feasible. They are also explained and evaluated in APHIS-WS Environmental Risk Assessments (Appendix F). As an example of the efficacy of the IWDM model over the past four decades, APHIS-WS has helped manage predation damage and increase tolerance for wolves as they met and exceeded recovery levels in the Northern Rocky Mountain and Great Lakes regions.

Predators and other native wildlife are valuable resources and important members of our natural ecosystems. APHIS-WS policies and decisions are based on the best available science. Our goal is to reduce local damage, not to manage predator populations. Thus, our actions focus on the individual animals causing damage. Our experts work hard to balance the needs of wildlife and people, and continue to find and encourage the use of the most effective, safe, environmentally-sound and practical methods for use in predation damage management.

1.13 WHAT ROLE DOES COST-EFFECTIVENESS PLAY IN IWDM AND NEPA?

A common concern expressed by commenters about government-supported PDM is whether the value of livestock or game population losses are less than the cost of using at least some public funds to provide PDM services. However, this concern indicates a misconception of the purpose of PDM, which is not to wait until the value of losses is high, but to prevent, minimize, or stop losses and damage where it is being experienced, the property owner's level of tolerance has been reached, and assistance is requested. Predator damage management would reach its maximum success if it prevented all losses or damage, which would mean the value of losses or damage due to predators would be zero. However, in the real world, it is not reasonable to expect zero loss or damage (see Section 1.11.2). Also, wildlife damage management involves not only the direct costs (costs of actual lethal and non-lethal management) but also the considerations of effectiveness, minimization of risk to people, property, and the environment, and social considerations (Shwiff and Bodenchuk 2004).

Evaluating the economic value of losses that would be avoided or minimized with implementation of PDM is inherently difficult and very complex (Shwiff and Bodenchuk 2004). Relevant scientific literature suggests that, in the absence of predation management, predation rates on livestock would likely increase (Bodenchuk et al. 2002; Section 1.11.2).

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. Attempting to evaluate the economic value of success of conservation projects, such as improving the number of surviving elk calves per 100 cows in an areas experiencing high predation in the spring, or the economic value of the predator itself is even more difficult, because wildlife populations have no inherent measurable monetary value, and any such value must therefore be evaluated indirectly, such as through willingness to pay for consumptive or non-consumptive recreation, for example (Section 1.13.6). Section 1.13.4 discusses other factors, complexities, and methods involved in evaluating the economic values of predator damage management.

1.13.1 Does APHIS-WS authorizing authority require an economic analysis?

No. The statute of 1931, as amended does not incorporate consideration of economic valuations and cost-effectiveness for the IWDM program as part of decision-making (Section 1.5.1). In addition to authorizing the IWDM services, it provides for entering into agreements for collecting funds from cooperators for the services the agency provides.

1.13.2 Does NEPA and the CEQ require an economic analysis for informed decision making?

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

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

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

The CEQ regulations at 40 CFR §1502.23 take 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-New Mexico 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 an important factor in PDM decisions but not the primary goal of APHIS-WS. Whenever a request for assistance is received, WS-New Mexico personnel consider additional constraints, such as environmental protection, land management goals, presence of people and pets, and social factors using the APHIS-WS Decision Model. These constraints may increase the cost of implementing PDM actions while not necessarily increasing its effectiveness, yet they are a vital part of the APHIS-WS program (Connolly 1981, Shwiff and Bodenchuk 2004).

Connolly (1981) examined the issue of cost-effectiveness of federal PDM and concluded that public policy decisions have been made to steer the program away from being as cost-effective as possible, including the restriction of management methods believed to be highly effective but less environmentally or socially preferable, such as toxic baits, including traps and the livestock protection collar (LPC), which is highly specific to the offending animal (Shelton 2004). Also, state and local jurisdictions are limiting the methods available for PDM. Thus, the increased costs of implementing the remaining more environmentally and socially acceptable methods to achieve other public benefits besides resource and asset protection could be viewed as mitigation for the loss of effectiveness in reducing damage.

Services that ecosystems provide to resources of value to humans can be considered in qualitative and/or economic terms. The Memorandum entitled "Incorporating Ecosystem Services into Federal Decision Making" issued by the CEQ, the Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP) on October 7, 2015 (https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2016/m-16-01.pdf does not require an economic test for the ecological services to be considered valuable.

The Memorandum states:

> "[This memorandum] directs agencies to develop and institutionalize policies to promote consideration of ecosystem services, where appropriate and practicable, in planning, investments, and regulatory contexts. (Consideration of ecosystem services may be

> accomplished through a range of qualitative and quantitative methods to identify and characterize ecosystem services, affected communities' needs for those services, metrics for changes to those services, and, where appropriate, monetary or nonmonetary values for those services.)…Adoption of an ecosystem-services approach is one way to organize potential effects of an action within a framework that explicitly recognizes the interconnectedness of environmental, social, and, in some cases, economic considerations, and fosters consideration of both quantified and unquantified information."

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

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

1.13.2.1 Are the recommendations of Loomis (2012) for economic analysis applicable to APHIS-WS activities?

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

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

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

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

The agencies the author uses as examples are those that either fund or construct major civil works actions (capital improvement projects) with long life spans, such as the US Army Corps of Engineers (USACE), the Federal Highway Administration (FHWA), the Bureau of Reclamation (BOR), Tennessee Valley Authority (TVA), and the Federal Emergency Management Agency (FEMA). Loomis (2012) especially uses the National Economic Development requirements for large water projects funded and/or constructed by BOR and USACE as the example for APHIS-WS use. However, Congress has specifically required that the BOR and USACE consider the National Economic Development (NED) for decision-making for their large civil works water projects (such as large dams, river management, etc.) that "necessarily confronts choices among possible alternative courses of actions that involve tradeoffs in economic and other opportunities" (USACE 2009). The NED is required because, as the report quotes from the USACE *Principals and Guidelines* "Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units… [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 BOR large water-related civil works projects is driven primarily by economic and public benefits considerations at the national level, with other factors given secondary consideration.

The NRCS, another example used by Loomis (2012), is required by Congress to conduct economic analyses for agency decision-making regarding whether to fund conservation projects, especially under Congressional statutes such as Farm Bills (NRCS Manual 200 Natural Resources Economic Handbook Part 613.0; http://directives.sc.egov.usda.gov/viewDirective.aspx?hid=37536). FHWA considers costs of various alternative ways of meeting highway transportation needs, but is not required to rely on the results of economic analyses for its decision-making.

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

1.13.3 How have recent studies considered economic evaluation of WDM activities?

Recognizing that many factors affect the viability and profitability of livestock operations, such as weather, the cost of wages and supplemental feed, livestock meat and wool market prices (Berger 2006), as well as the increase in synthetic fibers, predation on livestock is clearly one. NASS (2005) reported that predator losses represented a large percentage of losses when compared with six non-predator related losses of cattle and calves nationwide. For example, 190,000 losses of cattle and calves were reported by NASS in 2005. Compared to total losses, including predator losses, for losses due to poor health, losses during calving, and weather-related losses, predation accounted for 8.9%, 24.9%, and 40.9% respectively. Livestock losses due to predation 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 such protected habitats (Shelton 2004). A study in Wyoming of ranch-level economic impacts in a range cattle grazing system conducted by economics professors at the University of Wyoming (Rashford et al. 2010), indicates that predation on calves can have a substantial impact on ranch profitability and long-term viability through loss of calves available for sale, increased variable costs (such as hay and feeds, veterinary costs, fuel, equipment repair, trucking, and labor) per calf, and, anecdotally perhaps, weaning rates from predator harassment. The study found that increased calf loss "takes a larger toll on profits because it erodes the ranch's core profit center, calf sales…The results suggest that predation can have significant impacts on both short-term profitability and long-term viability depending on the mechanism [by which predation can affect profits]." The study identifies social and ecosystem benefits to keeping ranches in the western US viable and profitable through the open spaces and wildlife habitat they provide. The study concludes that "predator control activities would only need to reduce death loss due to predators or reduce predator impacts on weaning rates by approximately 1% to be to be economically efficient…The relationship between predation, ranch viability, and the ecosystem services provided may justify public spending on predator control." Conversely, at a larger scale, Berger (2006) suggested that 77% of changes in sheep numbers correlated positively with lamb prices, hay prices and wage rates, and suggested that cash or other subsidies might be more effective (see Section 1.13.7.2 for a discussion on compensation for depredation). However, APHIS-WS is requested to address losses due to predators at the producer level and does not address losses at a broader economic scale. Further research regarding ranch profitability at the producer level is needed, and differs based on ranch-level conditions, operations, and livestock type.

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

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

A team of economic specialists from the NWRC conducted an economic assessment of select benefits and costs of APHIS-WS in California. The assessment focused primarily on damage in agricultural areas because urban wildlife damage figures were not readily available. During the study year, cooperating California counties paid on average 57% of the cost of their WS-California specialists. Results of the study indicate that for every $1.00 California counties invest in APHIS-WS, they save between $6.50 and $10.00 in wildlife damage and replacement program costs (Shwiff et al. 2005). Considering the total cost of APHIS-WS field personnel, the benefits were found to be between $3.71 and $5.70 for every $1.00 of county investment.

Other studies have shown positive results for benefits to costs. 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 to benefit ratio of 1:8 for direct producer benefits, and a cost to 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 shooting. 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.

1.13.4 What are the various factors and methods for evaluating cost-effectiveness?

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

- **Direct Benefits:** These are typically calculated as the number of individual animals saved from predation, representing a cost savings, in that with predation management a certain number of losses or amounts of costs can be avoided. The dollar value of the species or animals saved represents the direct benefits of the program and the losses avoided by producers. However, determining the market value for livestock and wildlife species saved is difficult, with livestock usually valued using market price, which is typically conservative, and wildlife species using civil values. Number of animals lost in the absence of PDM activities is difficult to determine. Also reported losses are most likely substantially fewer than actual losses, as many losses are not reported to authorities, not all losses are found in the field, and many carcasses found are too consumed or decayed to make a clear determination of cause of death and species responsible.
- **Spillover Benefits (secondary, indirect, or incidental benefits):** These benefits are an unintentional side effect of the primary purpose of the PDM program, and may be evaluated using multiplier values from the direct benefits. Spillover benefits can include benefits to wildlife populations in the same geographic area. Indirect benefits can include benefits to local and regional economies.
- **Intangible Benefits:** Such benefits include increased cooperation from landowners as a result of the implementation of PDM, such as facilitating landowner participation in other

conservation efforts or potentially minimizing amateur efforts to control predators, which may not be as selective or humane as those conducted by trained professionals.

- **Direct Economic Effects/Costs:** These costs reflect the value of losses to the livestock operator and the associated reductions in purchases for directly supporting those livestock as well as the costs of lethal and non-lethal PDM activities for protection of livestock and/or localized wildlife species, such as valued big game species, recently introduced native species, or ESA-listed species,.
- **Indirect Economic Effects:** These effects are generated as livestock loss alters producer purchases of supplies from other industries in the region and outside the region, resulting in additional jobs, increased income for the region, and greater tax revenues.

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

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

- **Cost: Benefit Analysis:** Considers measures of costs that include financial costs (out of pocket expenditures such as for fencing and guard dogs) and opportunity costs (benefits that would not be available to society based on predator control actions taken) and measures of benefits as evaluated by a consumer's (increase in enjoyment/satisfaction) or producer's (increases in profit) willingness-to-pay (WTP) for one more unit of the identified "good", considered either on a personal level or societal level. On a personal level, the "good" is considered to have economic value if the individual person (recognizing that individuals have differing value systems) receives enjoyment/ satisfaction from the "good" and if the "good" is to some degree scarce. Opportunity costs must also be considered – costs/resources spent on a good that cannot then be used for another purpose. On a societal level, many public natural resources, such as wildlife, may not have a direct market value, but provide satisfaction and enjoyment to some (but not all) segments of society. This is a difficult and subjective analysis (despite its attempt at quantification), as the direct and indirect factors and discount rates included in such an analysis must be carefully considered and evaluated accurately for the contribution they play or this type of analysis can substantially misrepresent the actual situation and/or be readily disputed. See Section 1.14.2.1 for an explanation of how this approach is used for large capital improvement projects considered on a project-level basis but applied on a regional and national basis as the foundation for determining if and what level the federal government will provide Congressional appropriations. Congress requires this approach for several agencies for such capital improvement projects for setting federal policy in the large-scale public interest.
- **Willingness to Pay:** Studies have identified the WTP for non-market goods such as wildlife recreation (mostly hunting, fishing, and wildlife viewing) for individual species, and, to a substantially lesser degree, ecosystem services, such as clean drinking water, pollination and pest control for agriculture, and renewal of soil fertility. WTP can also be used to monetize existence or passive values, such as the value of knowing that a species exists somewhere in the wild, even if the individual never spends any money to actually experience it in the wild.
- Methods used to determine or using WTP have included:

- **Recreational Benefits:** Considering the costs of travel to experience enjoyment of non-market recreational experiences (Travel-Cost Method; TCM), using a demand curve above actual travel costs obtained through surveys with recreationists, reflecting actual behavior. Shwiff et al. (2012) summarize the primary criticisms of TCM: assumptions that visitors' values equal or exceed their travel costs, because travel costs are not an accurate proxy for of the actual value of the good; values must also be assigned to the time individuals spend traveling to the site, including opportunity costs (time spent traveling cannot be spent doing some other activity) since each person values their time differently; human access to conservation sites may be limited (including access to private land) and individuals may not be aware or have a preference toward the species associated with a chosen recreation site; and if individuals are not willing or able to travel to the site to expend funds, then this method confers no value.
- **Existence/ Altruistic/Bequest Benefits** (depending on whether the benefit is enjoyed by the individual now or by other individuals now, or by other individuals in the future): Constructing a hypothetical or simulated market and surveying individuals if they would pay an increase in their trip costs or an increase in their taxes/utility bills/ overall prices for increasing environmental quality, including wildlife populations, recognizing that they higher the dollar amount respondents are asked to pay, the lower the probability that they would actually pay (Contingent Valuation Method; CVM). This includes situations in which individuals are willing to provide donations to environmental groups to protect resources that they care about but may never experience themselves. Shwiff et al. (2012) summarize the primary criticisms of CVM: the hypothetical nature of the questionnaires, the inability to validate responses, the high costs of conducting this type of survey, and the difficulty of identifying the target audience. Also, public goods such as wildlife to not lend themselves to this type of valuation and this valuation tends to understate the true non-market value.
- **Benefit Transfer to Other Locations:** Extrapolation of WTP results from one area to another, recognizing that the extrapolation may or may not be reasonable or applicable in another area depending on circumstances. Shwiff et al. (2012) summarize the primary criticisms of the benefit transfer method: the reliability of this methods may be inconsistent as this method depends on estimates created using the CVM or TCM methods; wildlife values in one area may be unique and simply transferring the value associated with a species in one location to the same species in another location does not capture local qualities; preferences and willingness to pay for those preferences may not account for all the values and benefits of wildlife conservation projects, including ecosystem services.
- **Regional Economic Analysis:** Shwiff et al. (2012) describe this method as including estimation of secondary benefits and costs associated with the conservation of wildlife species in units of measure that are important to the general public (revenue, costs, and jobs). Increasing wildlife populations (the primary benefit) may have secondary benefits such as increase consumptive and non-consumptive tourism, which can be estimated using multipliers to account for changes spread through economic sectors. Loomis and Richardson (2001) used WTP estimates obtained from CVM and TCM studies for estimating the value of the wilderness system in the US. This requires the use of computer models, which can translate conservation efforts into regional impacts on revenue and jobs. However, secondary benefits or costs cannot be incorporated into a

cost:benefit analysis because losses in one region may become gains in another region, potentially leading to offsetting effects.

As Schuhmann and Schwabe (2000) conclude:

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

In addition, the Paperwork Reduction Act of 1995 requires agencies to submit requests to collect information from the public to the Office of Management and Budget (OMB) for approval for surveys used for general-purpose statistics or as part of program evaluations or research studies. (https://www.whitehouse.gov/sites/default/files/omb/inforeg/pmc_survey_guidance_2006.pdf). Therefore, any surveys conducted for the purposes of determining WTP and related questions must have all survey questions and designs approved by the OMB. Developing a high quality survey require professional assistance in designing, executing, and documenting their surveys. This requirement makes it very difficult and expensive to conduct public surveys.

1.13.5 What are the economic results of the Marin County CA predator damage replacement program compared to the WS-California program?

1.13.5.1 What is the Marin County predator damage replacement program?

In 2001, Marin County, California, located north of the San Francisco Bay, created a program for protection of commercial sheep enterprises, called the Marin County Livestock Protection Program. This program redirected the funding Marin County previously spent on an PDM contract with WS-California to a County-run cost-share program reimbursing producers for exclusion and other non-lethal method expenses. The program 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 Marin County Livestock Protection Program, qualified ranchers are provided cost-share funding to assist in the implementation of non-lethal management methods to reduce depredation such as new fence construction or improvements to existing fences, guard animals, scare devices, or changes in animal husbandry (herders and shed lambing). 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 (Larson 2006). The Marin County program provides an opportunity for cost recovery to enrolled landowners for the purchase or maintenance of non-lethal or exclusionary equipment or maintenance or purchase of guardian animals. The program requires receipts be turned in for supplies/equipment purchased and/or proof of maintenance projects or guardian animals be otherwise documented with the Agricultural Commissioner, but does not require reporting of application of non-lethal methods, resource protection numbers, predation losses, or any other measure of success. The amounts available to producers have varied throughout the program with up to $3000 being available to large sheep operations (those with more than 200-300 ewes) and from $500 to $1500 available to smaller producers (Larson et al. 2016).

Initially, producers who qualified for the program could also receive compensation for sheep and lambs lost to predation. 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 by native predators, feral swine (wild hogs and boars), free roaming and/or feral dogs, and other common wild animals, Marin County indicated that the Livestock Protection Program was only a cost-share program which provided limited funds for purchasing fencing materials and guard animals. There are differing accounts as to why the indemnity portion of the program was discontinued. Larson 2006 paper stated that 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. In contrast, statements from the Marin County Agricultural Commissioner have attributed the change in program funding as a response to producer feedback requesting the County prioritize prevention over indemnity. Regardless of the reasons, the indemnity portion of the program has been discontinued.

1.13.5.2 How do the costs of the Marin County program compare to WS-California program?

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 1.3 times the amount that the cooperative APHIS-WS PDM program cost the county in its highest year (Larson et al. 2016). Marin County's annual cost has ranged from a low of $5400 in FY 2011–FY 2012 to a high of $50,354 in FY2002-2003. The average annual cost of the Marin County Livestock Protection Program from 2001-2015 was $28,349 (Larson et al. 2016). This budget evaluation only recorded the county's cost for implementation, and did not capture the additional landowner costs associated with this program. This cost estimate is for a program limited to providing financial compensation assistance with non-lethal predator damage management to protect livestock and poultry operations larger than a certain size. It does not provide trained personnel to apply this cost-shared equipment in the field or address several of the needs for action that WS-New Mexico work on as identified in Chapter 1, including protecting smaller herds of livestock, property protection, work at airports, for public/pet health or safety, or to protect natural resources, including ESA-listed species (Sections 1.11.2 through 1.11.5), nor do non-lethal methods always resolve the predator management problem, even for operations that do qualify for cost-share assistance. The cost of an expanded cost-share program aimed at responding to all of the WS-New Mexico needs for action would be considerably more than the estimate for the operation of the Marin County Livestock Protection Program which has a narrower scope of protection.

1.13.6 What are the economic concerns commonly expressed by public commenters to APHIS-WS PDM EAs?

Commenters often request economic analyses that incorporate the combination of the economic contributions of resource and agricultural protection programs and the economic contribution of wildlife-related recreation and values of the existence of wildlife, especially predators, on ecosystem services and recreation opportunities. Aspects of these values are included in this EA in the evaluation of impacts to target and non-target populations (Sections 3.5 and 3.7), ecosystem services and biodiversity (Section 3.8), [sociocultural/wildlife values] and impacts to the recreation experience (various sections of Section 3.10).

Commenters to APHIS-WS PDM EAs commonly express concerns about the economic costs of PDM in relation to the economic values being protected, especially values related to livestock, and whether the use of public funds are appropriate to support private profits. These are discussed and several are included in Section 2.5, Alternatives Not Considered in Detail.

1.13.6.1 Use of taxpayer funds for private profit, livestock losses considered a tax write-off, and livestock losses should be an accepted cost of doing business.

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

The national policy of using taxpayer dollars for subsidizing private or commercial profit, such as for protecting livestock from predators on private or public lands is established by Congress through statutes such as the Federal Land Policy and Management Act (FLPMA), the Multiple Use-Sustained Yield Act requiring multiple use of federal lands, including for livestock grazing, and the APHIS-Wildlife Services authorizing act (Section 1.5.1), 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-New Mexico is also funded by private and commercial entities that request its services.

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

WS-New Mexico is aware of beliefs that federal wildlife damage management should not be allowed until economic losses become "unacceptable," (Section 1.4.3) and that livestock losses should be considered as a cost of doing business by producers. WS-New Mexico 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-New Mexico is authorized to respond to requests for assistance with wildlife damage management 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 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 (Section 1.5.1 and 1.13.1).

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.

1.13.6.2 Compensation for losses or damage should replace APHIS-WS PDM

Wildlife is typically managed by the state, regardless of land ownership. There is currently no national program to equitably distribute the costs of damage by predators covered in this EA between all consumptive and non-consumptive user groups. APHIS-WS does not have the authority to establish and/or administer such as program. The decision about how to distribute the costs of wildlife management is usually considered a component of state wildlife management decisions, except for those species managed by the USFWS.

Some states and counties have established programs that partially accept monetary responsibility for some types of wildlife damage (for example, Bruscino and Cleveland 2004). Other states and counties have declined to establish such programs, presumably because they are satisfied with the current balance of the costs of managing predator damage. New Mexico has no other legal process for paying compensation for losses caused by predators. APHIS-WS has no legal authority or jurisdiction to provide financial compensation for losses.

The U.S. Fish and Wildlife Service in cooperation with the National Fish and Wildlife Foundation, established the Mexican Wolf/Livestock Interdiction Trust Fund. The 11-member Mexican Wolf/Livestock Council has the authority to identify, recommend and approve conservation activities, identify recipients and approve the amount of compensation for Mexican wolf depredations in New Mexico.

The Agricultural Act of 2014 (aka the 2014 Farm Bill) has provisions for the federal government to provide indemnity payments to eligible producers on farms that have incurred livestock death losses in excess of the normal mortality, as determined by the Secretary of Agriculture, due to attacks by animals reintroduced into the wild by the Federal Government (such as wolves) or protected by Federal law (such as animals protected under the Migratory Bird Protection Act or the Endangered Species Act). Payments are equal to 75% of the market value of the applicable livestock on the day before the date of death. The Secretary of Agriculture or designee makes that determination. None of the predators considered in this EA are applicable under this statute.

Even if Congress did grant APHIS-WS authority to administer a compensation program, such a program would also require significant additional appropriations. Costs associated with locating and confirming all, or at least a significant majority of, predator losses statewide to implement a compensation program are likely to meet or exceed the WS-OR budget, even if resources are reallocated from current operational and technical assistance projects to confirming losses. Searching for lost animals, especially in large grazing allotments or pastures, in areas with remote and/or rough terrain, and areas with extensive shrubs or trees, can be extremely labor intensive. In general, this level of intensive monitoring has only been feasible for limited-scale research projects.

Difficulties related to a compensation-only alternative extend beyond jurisdictional and financial challenges. Reviews of compensation programs indicate that these programs do not generally improve people's tolerance of the species causing damage (Treves et al. 2009) and do not address indirect costs of wildlife damage (Steele et al. 2013). Compensation programs for recovering wildlife species can, in some cases, increase to the point where funds needed for compensation undermine budgets for conserving other species (Treves et al. 2009). Some authors have raised concerns that compensation programs may make producers less risk-averse and less likely to adopt new or improve existing management practices. Bad managers may be compensated at the expense of those who invest in good management techniques. The challenges of designing and managing compensation schemes are so intensive that managers seldom evaluate the overall cost-effectiveness in comparison to the benefits (Nyhus et al. 2003, Bulte and Rondeau 2005, Treves et al. 2009). Treves et al. (2009) suggest that compensation does not necessarily improve tolerance for depredating wildlife, and some producers may reject payments in favor of lethal control.

Compensation could actually increase the number of depredations, which is contrary to the APHIS-WS objective of encouraging co-existence with wildlife. Bulte and Rondeau (2005) recommend conducting "a careful assessment of local ecological and economic conditions before compensation is implemented."

NMDGF is better positioned than WS-New Mexico to conduct such thorough, multifaceted assessments of its localities to assess, adjust, and monitor the viability of a local compensation program, given its unique ecology and economic conditions. NMDGF is also better equipped to decide the appropriate balance of risk and liability between all consumptive and non-consumptive groups for the wildlife it manages. For these reasons, WS-New Mexico believes that establishing a compensation program for predator damage is not feasible, and that this issue is appropriately addressed through political processes at the state and federal levels.

1.13.6.3 Livestock producers should pay all costs of PDM

The Act of 1931, as amended, authorizes the Secretary of Agriculture to make expenditure of resources for the protection of agricultural resources. Congress makes annual allocations to APHIS-WS for the continuing federal action of WDM, including PDM. Congress further establishes that APHIS-WS may receive and retain funds provided by other entities (e.g., States, industry, public and private funds) and use them towards those programs from which funds were received. In New Mexico, this funding is made up of about 50% from Congressional appropriations, 15% from state agreements, and 29% from private or commercial cooperators. Cooperators pay the costs of non-lethal actions taken, even when recommended by WS-New Mexico personnel, and a substantial proportion of the cost for WS-New Mexico efforts, including WS-New Mexico administrative overhead.

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

1.13.6.4 WS-New Mexico should subsidize nonlethal methods implemented by resource owners

WS-New Mexico is a cooperatively funded program with over 35% of funding comprised of non-appropriated (non-federal) dollars. Cooperators provide the direction to WS-New Mexico on the types of services they want delivered with the funding they provide and it is implemented in accordance with program policies. Although WS-New Mexico does occasionally loan some harassment equipment, cooperators request that WS-NM focus its efforts on those services that the public is less skilled or proficient in doing. Cooperators rely on WS-New Mexico to provide technical assistance needed for individuals (including individuals supplementing WS-New Mexico efforts) to use their own resources and efforts. Use of appropriated dollars to subsidize the purchase of non-lethal methods would impact the support infrastructure which enables other entities to cooperate with WS-New Mexico. The State of New Mexico also provides no subsidies for non-lethal methods to resolve damages from the predator species covered in this EA. Subsidies for purchase of non-lethal methods to selected types of livestock producers is currently offered in Marin County, California by the County to some degree, but the costs and effectiveness are not clearly known (Shwiff et al. 2005, Shwiff et al. 2006; Sections 1.13.5 and 2.5.24).

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

1.13.6.5 Incorporate the environmental costs of livestock grazing on public lands into cost analyses

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

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

1.13.6.6 No federal funds should be used to support state PDM for protection of game species

Under some circumstances, reducing predation can be an important management tool to maintain specific wildlife management objectives. Managing game species in New Mexico is the responsibility of the NMDGF and any decision to reducing predation to benefit local game populations would be the responsibility of the NMDGF. However, WS could provide assistance if requested by the NMDGF.

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

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

1.13.6.7 APHIS-WS should be financially liable for pet dogs that are incidentally killed during operations

WS Directive 2.340 addresses requests for assistance associated with feral (an ownerless or homeless wild dog), free-ranging (dogs that have owners but not under the owner's direct control), or hybrid dogs (a canid that is the progeny of a domestic dog and a wild wolf or coyote that is either feral or free-ranging). In New Mexico, the primary responder to damage caused by dogs is either a local animal control authority or the Sheriff's office. However, WS-New Mexico can respond upon request for assistance from the NM Department of Health, county sheriff or animal control when dogs cause damage to livestock, poultry and to protect human health or safety (2.325NM).

The primary concern, however, is when WS-New Mexico 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-New Mexico field personnel take appropriate actions to avoid incidental take of pet dogs and do not set devices that could capture dogs in recreational areas whenever possible. All capture traps are set to minimize the risk of damage to the animal (Section 2.4 and 3.9). If the dog has identification allowing determination of the owner, the owner is informed as soon as possible. If not, then the dog is released on site.

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

1.13.6.8 PDM should be funded through a state head tax

It is the policy of the Federal government that a livestock head tax for funding PDM must be established voluntarily and through authorities other than the Federal government.

This issue is appropriately addressed through the political process at the state or county level.

Chapter 2 ALTERNATIVES

2.1 WHAT IS INCLUDED IN THIS CHAPTER?

This chapter describes:

- Detailed descriptions of the five WS-New Mexico PDM alternatives evaluated in detail in Chapter 3, including the current level of WS-New Mexico PDM operations (no action alternative) and various levels of WS-New Mexico involvement in PDM activities in New Mexico;
- APHIS-WS directives and associated protective measures that WS-New Mexico must follow, and state laws and regulations that all those involved in management of predator damage and who take wildlife lethally for a variety of purposes, including private citizens,
- and PDM alternatives that are not evaluated in detail in this EA, with rationale.

2.2 WS-NEW MEXICO ACTIVITIES INCLUDED IN EACH ALTERNATIVE

The five alternatives are described in detail below. The effectiveness of each of these alternatives in addressing WS-New Mexico objectives (Section 1.5.2) is evaluated in Section 3.13). Alternatives that were determined not to be reasonable, practical, or effective are described in Section 2.5, with the rationale provided for not evaluating each one in detail. Protective measures, APHIS-WS policies, and relevant state laws and regulations for addressing the issues are identified in Section 2.4 after the description of the alternatives and incorporated into all alternatives as applicable that include WS-New Mexico activities.

2.3 ALTERNATIVES CONSIDERED IN DETAIL

The following alternatives are evaluated in detail in this WS-New Mexico PDM EA.

Alternative 1: Proposed Action/No Action Alternative - Continue WS-New Mexico Predator Damage Management Activities, with reasonable fluctuations in program delivery, and lethal and non-lethal operational and technical support.

Alternative 2: WS-New Mexico provides lethal and non-lethal technical assistance and only non-lethal preventive and corrective operational assistance. WS-New Mexico could provide lethal and non-lethal technical assistance, and/or non-lethal operational assistance, but would not provide lethal operational assistance.

Alternative 3: WS-New Mexico provides non-lethal PDM assistance before lethal assistance. WS-New Mexico would provide both technical assistance and operational assistance, but reasonable application of non-lethal methods would have to be shown ineffective to resolve the damage/threat before WS-New Mexico could take lethal action. WS-New Mexico would not provide proactive assistance, and lethal assistance could not be taken until WS-New Mexico has confirmed and recorded that reasonable non-lethal actions have not resolved the problem.

Alternative 4: WS-New Mexico provides lethal PDM only for human/pet safety or to protect ESA listed species. WS-New Mexico provides full PDM assistance, including lethal and non-lethal assistance, only when requested for protecting human/pet health or safety or to protect federally-listed species; all other assistance would only use non-lethal methods and/or technical assistance.

Alternative 5: No WS-New Mexico PDM Activities. WS-New Mexico would not conduct PDM activities in New Mexico. PDM would still be implemented by other legally authorized entities, such as NMDGF, NMDA, USFWS, property owners, and commercial PDM companies.

2.3.1 Alternative 1: Proposed Action/No Action Alternative: Continue WS-New Mexico Predator Damage Management Activities.

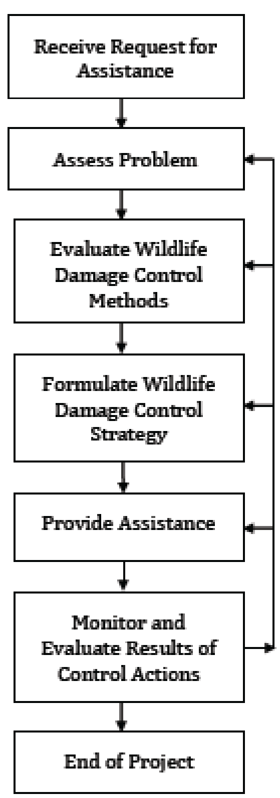
2.3.1.1 Why is the proposed action also the "no action" alternative?

Where a proposed action is also the "no action" alternative, the CEQ states:

> "In situations where there is an existing program, plan, or policy, CEQ expects that the no-action alternative …would typically be the continuation of the present course of action until a new program, plan or policy is developed and decided upon (40 Fed. Reg. 18026, March 23, 1981)."

Therefore, the current program, with natural fluctuations in PDM actions, locations, and tempo, is also the no action alternative. The impacts of all other alternatives considered in detail will be compared to the impacts of the current program, acting as the no action alternative.

2.3.1.2 How do WS-New Mexico personnel select an PDM strategy using the WS Decision Model?



Step-by-step discussion

1. Receive Request for Assistance: Wildlife damage management services are provided only in response to requests for assistance.
2. Assess Problem: First, a determination should be made as to whether the problem is within the authority of WS. If it is, damage information should be gathered and analyzed to determine factors such as what species was responsible for the damage; the type, extent, and magnitude of the damage, the current economic loss and potential losses, the local history of damage, and what management methods, if any, were used to reduce past damage and the results of those actions.
3. Evaluate Management Methods: Once a problem assessment is completed, an evaluation of management methods must be conducted. Methods should be evaluated in the context of their legal and administrative availability and their acceptability based on biological, environmental, social, and cultural factors.
4. Formulate Management Strategy: Methods determined to be practical for use are formulated into a management strategy. The concept of IWDM should be applied when formulating each management strategy. This approach encourages the use of several management techniques rather than relying on a single method. Consideration of factors such as available expertise, legal constraints on methods used, costs, and effectiveness is essential in formulating each management strategy.
5. Provide Assistance: Program service can be provided by two basic means; technical assistance and direct management (WS Directive 2.101, Selecting Wildlife Damage Management Methods).
6. Monitor and Evaluate Results of Management Actions. When direct management is provided, it is necessary to monitor the results. Monitoring is important for determining whether further assistance is required or whether the problem has been resolved. Evaluation is used to determine whether additional techniques are necessary.
7. End of Project: With technical assistance, the projects normally end after recommendations or advice are provided to the requestor. An operational project normally ends when WS personnel have stopped or reduced the damage to an acceptable level. Problems such as chronic predation on livestock or at aquaculture facilities may require continuing or intermittent attention and may have no well-defined end point.

Methods are evaluated for their availability and suitability based on biological, economic, environmental, and social considerations. Following the though process, the methods deemed practical for the situation are developed into a management strategy. The WS Decision Model is designed to serve as a useful management tool and meaningful communication instrument; however it necessarily oversimplifies complex thought processes.

Wildlife Services updated Directive 2.101 in 2009 which provides guidelines used for basic decision-making, selection of management methods and techniques, and program direction. WDM is practiced as a field of specialization within the wildlife management profession. WS personnel may provide services via technical assistance, direct-control assistance, or both.

Technical assistance and direct-control assistance encompass the use of nonlethal and lethal management methods. In some situations, such as livestock protection, the number of nonlethal methods available to the professional wildlife damage specialist for use in direct-control assistance is currently limited. Most of these nonlethal methods focus on management of the affected resource and not on control of the offending animal. In these instances, WS involvement in using nonlethal methods may be limited to technical assistance recommendations which are more appropriately applied by the resource owner. These methods may include the use of livestock guarding animals, the electronic guard or other noise making device, predator-proof fencing, fladry, shed lambing, herding, and nigh penning. To continue providing Federal leadership in managing problems caused by wildlife, WS supports and promotes scientific research to develop and improve WDM methods and to provide science-based information for WDM.

WS activities are developed, conducted, and/or supervised by professionals who are knowledgeable in the biological, ecological, economic, and social principles that govern wildlife management decisions. Periodic field inspections, program audits, report monitoring, and customer feedback help to ensure program compliance with applicable laws, regulations, and policies.

When responding to requests for assistance, WS may provide technical assistance, direct control assistance, and/or research assistance. Technical and direct control assistance may involve the use of either lethal or nonlethal methods, or a combination of the two. Preference is giving to nonlethal methods when practical and effective.

In selecting damage management techniques for specific wildlife damage situations, consideration must be given to the status of target and potential nontarget species, local environmental conditions, relative costs of applying management techniques, environmental impacts, and social and legal concerns. These factors must be evaluated in formulating management strategies and may include the application of one or more techniques.

2.3.1.3 What is the process for verifying losses and damage?

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

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

When insufficient evidence remains to verify depredation, the loss is considered to be *reported* and the species most likely to have cause the damage is recorded in the MIS database. WS-New Mexico can then take appropriate action in accordance with APHIS-WS policy and state and federal law.

In most cases, when addressing livestock predation, WS-New Mexico field personnel do not attempt to locate every depredated carcass reported by ranchers, but attempt to verify sufficient levels of damage to establish the need to take action and develop the appropriate strategy using the WS Decision Model (APHIS-WS Directive 2.201). In many cases, damage reported by WS-New Mexico does not actually reflect the total number of livestock or other resource affected, but provides sufficient information to develop the management strategy. Since producers experiencing loss may or may not contact WS-New Mexico to report their losses or to request assistance, even fewer instances of depredation are documented. Producers often try to resolve the damage themselves or may request the assistance from other entities, such as commercial companies (Section 1.7).

2.3.1.4 Background to the proposed action/no action Alternative

The Proposed Action/No Action alternative continues the current implementation of an adaptive integrated approach utilizing all legal non-lethal and lethal methods in New Mexico (section 2.4.4 and Appendix A), identified through use of the APHIS-WS Decision Model, to reduce damage and threats caused by predators in New Mexico. New Mexico Senate Bill 32 (Section 2.4.4.7) changes several policies for how WS-New Mexico will conduct PDM on public lands compared to past actions. Section 2.4.3.4 outlines the policies WS-New Mexico will implement to comply with senate bill 32. WS-New Mexico's implementation of these operating policies will go into effect when the decision document is signed for this EA, or no later than the Senate Bill 32 deadline of April 1, 2022.

A major goal of the WS-New Mexico program is to resolve and prevent damage caused by predators and to reduce threats to human safety. To meet this goal, WS-New Mexico continues to respond to requests for assistance with technical assistance and/or operational assistance to entities that enter into an agreement with WS-New Mexico. APHIS-WS activities are authorized by federal law and funded by both Congressional appropriations and funds provided by entities that enter into agreements with APHIS-WS state offices. For WS-New Mexico activities, this funding is made up of Congressional appropriations (about 50%), Federal and state interagency agreements (about 5%) and private, commercial, or other cooperators (about 36%).

To be most effective, PDM activities should begin as soon as predators begin to cause damage or are expected to begin to cause damage, such as in the spring during coyote pupping while livestock are simultaneously lambing or calving. Waiting until damage is ongoing may make the problem more difficult to resolve since individual animals become conditioned to a particular location. For example, the method of making an area with vulnerable livestock unattractive can be difficult to achieve if damage has been ongoing. WS-New Mexico works closely with those requesting entities to identify situations where damage could occur. WS-New Mexico personnel implement or recommend effective non-lethal and/or lethal damage management activities as early as possible in order to increase the likelihood of those methods achieving the appropriate level of damage reduction.

Under this alternative, WS-New Mexico will continue to conduct PDM in consultation with NMDGF and NMDA and will continue to respond to requests for assistance by:

- Taking no action if warranted;
- Providing non-lethal and/or lethal technical assistance to property owners or managers on actions they could take to reduce damages caused by mammals; or
- Providing non-lethal and lethal operational assistance and, when appropriate, technical assistance to a property owner or manager.

WS-New Mexico also continues to work with NWRC to produce educational materials and works with NMDGF, NMDA, and other agencies and cooperators to distribute materials and provide educational programs on methods for preventing or reducing predator damage.

2.3.1.5 What are the general components of the WS-New Mexico activities in alternative 1?

The current WS-New Mexico wildlife damage management approach includes the following general components:

- **Collaboration and Project Identification**

APHIS-WS state programs enter into cooperative partnerships in all aspects of operational wildlife damage management when requested by agency partners, tribes, and private entities. Cooperative partnerships may be developed to implement PDM for targeted resource protection, such as agricultural areas, areas with threatened or endangered species and other natural resources, urban/suburban areas to reduce property damage, or to protect human health and safety (Sections 1.12.2 through 1.12.6).

- **Education and Training**

WS-New Mexico provides professional courses and training to agencies, organizations, the public, property owners and managers, and cooperators on topics such as wildlife management and biology, wildlife damage management, and non-lethal and lethal techniques for managing the risk of damage to encourage co-existence. Many APHIS-WS personnel, including scientists at the NWRC publish professional papers and speak at conferences and meetings to further the science and application of wildlife damage management.

- **Technical Assistance**

Property owners or managers requesting assistance from WS-New Mexico are provided with information regarding the use of effective and practical non-lethal and lethal techniques and/or PDM strategies, including advice, training, and, to a limited degree, loan of equipment. Technical assistance training can be over the phone, on-site, or in instructional meetings. WS-New Mexico provides training on depredation investigations related to human health and safety to NMDGF, law enforcement, and other officials. Additionally, WS-New Mexico provides training to the public on how to avoid wildlife conflict and conducts workshops on non-lethal methods for producers and resource owners. Technical assistance is described in detail in Appendix A.

- **Operational Assistance**

WS-New Mexico wildlife damage management activities involve an integrated approach using a range of non-lethal and lethal techniques which can be used singly or as part of an integrated approach.

Property owners or managers may choose to take lethal management action themselves when authorized by law without consulting another private or governmental agency recommendations on their own. They can also use contractual services of private businesses, use volunteer services of private organizations, requests assistance from NMDGF and/or its agents, request to use the services of WS-New Mexico (direct operational assistance), or take no action.

- **Preventive (Proactive) Damage Management**

Preventive PDM is a strategy that applies lethal and/or non-lethal PDM action before expected damage occurs, based on historically recurring problems. Most non-lethal methodologies, whether applied by WS-New Mexico or resource owners, are used to prevent damage from occurring and therefore fall under this category of PDM methods. When requested, WS-New Mexico personnel can provide information, conduct demonstrations, or take direct action to prevent additional losses from recurring.

For example, in areas where substantial livestock depredations have occurred on lambing or calving grounds in the past, WS-New Mexico may provide technical assistance in the form of information about livestock guarding animals, fencing, or other husbandry techniques. Additionally, if requested and appropriate, WS-New Mexico may conduct lethal predator management by removing multiple predators in a specific area before lambing or calving begins to prevent depredations.

The rationale for conducting preventive damage management differs little in principle from holding controlled hunts for deer or elk in areas where agricultural damage has been a historical problem. By reducing the number of predators, specifically coyotes, operating in a territory near livestock, the risk of damage at the time is potentially reduced. Rather than requesting assistance from WS-New Mexico, property owners may request NMDGF and/or its agents, commercial companies and/or those with NMDGF permits for aerial depredation (17-3-43 NMSA 1978) to conduct such activities.

- **Corrective Predator Damage Management**

Corrective PDM is applying PDM strategies to stop or reduce current losses. Corrective actions may include a combination of wildlife damage management approaches, technical assistance, and operational damage management assistance"

For example, in areas where verified livestock depredations are occurring, WS-New Mexico field specialists may provide information about livestock guarding animals, fencing or husbandry techniques, and/or conduct operational, often lethal, damage management activities to stop the losses.

Corrective PDM methods are intended to be short-term strategy for reducing damage currently occurring. However, these methods cannot ensure predators do not return once those methods are discontinued. Property owners may request NMDGF and/or its agents, commercial companies, those with NMDGF permits for aerial shooting (17-3-43 NMSA 1978) and or conduct such activities themselves rather than requesting assistance from WS-New Mexico.

- **Carcass Disposal**

WS personnel abide by policies described in WS Directives 2.510 and 2.515 (Section 2.4) for carcass disposal. WS-New Mexico typically disposes of carcasses by moving them out of view into a brush pile, placing them in existing carcass pits on private property, and occasionally disposing of them in designated landfills or transfer stations when other methods are not feasible or available. Animals taken during aerial operations are seldom if ever recovered because it is not always safe to land aircraft in the field, and it is seldom cost-effective or time-effective to make multiple landings during a flight. Also, aircrafts have weight restrictions which control transportation of extra cargo for safety reasons, which is especially critical for low-level flights.

- **Monitoring**

The impacts discussed in this EA are monitored and evaluated in two ways:

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

2.3.1.6 What types of actions are included in alternative 1?

Alternative 1 continues the current WS-New Mexico PDM assistance as requested, accounting for inherent, realistic fluctuations in program delivery.

Most requests for PDM assistance come from private resource owners, particularly livestock operators, who may utilize private and/or public lands for grazing during some part of each year.

WS-New Mexico also receives requests for PDM assistance to protect other assets, such as:

- Domestic pets and personal and commercial structures or properties;
- Natural resources, from NMDGF and tribes; and
- Human health and safety, from private and government entities.

Most of these requests come from private individuals; however, requests for assistance may also come from public entities, such as NMDGF, NMDA, and other local, state, federal, or tribal entities. PDM assistance provided by WS-New Mexico personnel may be conducted on public, private, state, tribal, and other lands or any combination of these land class types, as appropriate (Section 1.8 and Table 2.2).

APHIS-WS has signed national level MOUs with BLM, USFS, and the USFWS. In addition, WS-New Mexico has signed agreements with NMDGF and NMDA to provide wildlife damage management services upon request (Sections 1.8 and 1.9). Usually, requests for management work on BLM and USFS land is from the livestock permittees. All anticipated WS-New Mexico activities on USFS and BLM lands are outlined in WS-New Mexico Annual Work Plans for each National Forest and BLM area of interest, usually grazing allotments. When work is proposed, annual coordination meetings are held between WS-New Mexico and personnel from the land management agencies to discuss accomplishments, status of work, monitoring, issues of concern, and any anticipated changes in proposed work plans.

2.3.1.7 In what types of areas would WS-New Mexico operate?

These areas include sites/locations where PDM is anticipated to continue to occur or reoccur and WS-New Mexico has been requested to actively work or is considering accepting work. These planned activities are those that are covered under existing cooperative agreements or are identified along with planned management areas in Annual Work Plans with the USFS or BLM. Livestock depredation control work is mostly concentrated in areas where livestock are most abundant and during times when they are most vulnerable to predators such as during calving and lambing. Requests for assistance in reducing property damage, protecting natural resources, and threats to human/pet health and safety are by their nature intermittent and thus less predictable in time and geographic location.

The current level of WS-New Mexico activities, the need for assistance, the frequency, locations, cooperators (private, state, federal, tribal and others), varieties of PDM work, and numbers of target and non-target animals taken fluctuates due to natural environmental conditions. WS-New Mexico recognizes that requests for its assistance are on a case-by-case basis. The EA uses conservative estimates for anticipating the impacts of continuing WS-New Mexico PDM assistance.

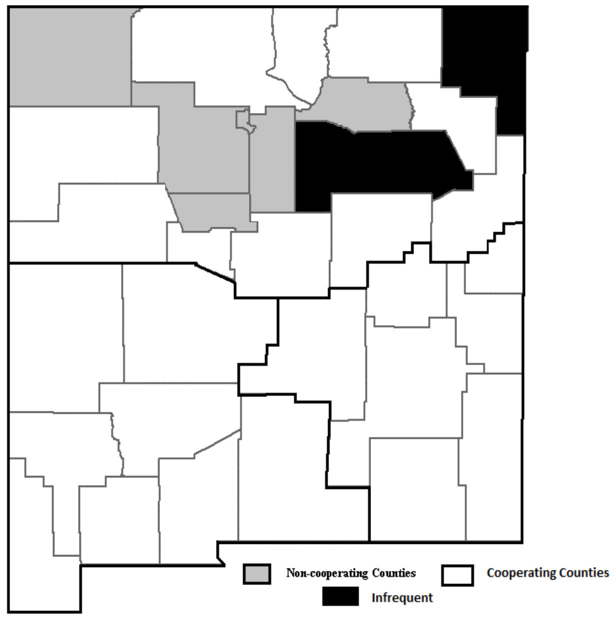
Alternative 1 includes any PDM actions throughout New Mexico in which WS-New Mexico has operated or would foreseeably operate even if those areas are not currently under agreements (Figure 2.2).

Unforeseen areas or currently unplanned activities, including emergency response, are areas or locations where WS-New Mexico has not operated or had agreements to operate, yet an entity experiencing predator damage, threats, or risks to human/pet health or safety requests assistance from WS-New Mexico. Unforeseen PDM activities are handled on a case-by-case basis as the need arises, in response to a request. If PDM is requested on lands classified as other than private, WS-New Mexico coordinates with the land management agency as agreed upon in MOUs, Work Plans, or other agreements.

This alternative includes WS-New Mexico conducting PDM operations within currently unforeseen areas as long as the operations are consistent with actions and impacts as described in this EA, as applicable:

- Federal and state law and regulations;
- APHIS-WS policies and Directives;
- Lethal and non-lethal methodologies as described and applied according to this EA;
- The protective measures included in this EA;
- Federal land management plans and federal Annual Work Plans and state or tribal objectives and requirements, including those areas with special designations, such as wilderness areas and wilderness study areas;
- The results of formal and informal consultations with the USFWS per the ESA (Section 3.6);
- Sustainable population levels as evaluated in Sections 3.5 and 3.7; and
- The actions would not trigger substantive environmental issues or effects that are not addressed in this EA.

Figure 2.2. Areas within which WS-New Mexico has operated in the state, and within which it could respond to requests for assistance under Alternative 1.



2.3.1.8 What types of methods are used in alternative 1?

As detailed in Appendix A, WS-New Mexico can use and/or recommend many methods, including combinations of methods for PDM strategies.

WS-New Mexico, NMDGF and/or its agents, commercial companies, NMDGF permitted aerial operators, or the property owners themselves may implement PDM methods. Implementing non-lethal methods such as husbandry or structural barriers are generally the responsibility of the property owners. Depending on the circumstances of a particular PDM situation, lethal methods may be needed to address the immediate problem during the time period while non-lethal methods are implemented. The design of the APHIS-WS Decision Model (Section 2.3.1.2), which provides for the consideration of lethal and non-lethal methods, allows WS-New Mexico to use and recommend the most effective and practical methods available, while accounting for the many legal, logistical, biological, ethical, and environmental variables in each unique damage situation.

Detailed descriptions of lethal and non-lethal methodologies are found in Appendix A; brief summaries are included below.

- **Non-lethal methods**

Non-lethal methods can be used to disperse, prevent or restrict access or otherwise make an area unattractive to predators causing damage, thereby reducing the risk that predators can cause damage or threats at the site and immediate area. Non-lethal methods are given priority by WS-New Mexico when addressing requests for assistance, when applicable and effective (WS Directive 2.101). However, non-lethal methods are not necessarily used to resolve every request for assistance if deemed inappropriate or potentially ineffective by WS-New Mexico's personnel under the APHIS-WS Decision Model within the practices of PDM (Section 2.3.1.2, Figure 2.1). WS-New Mexico personnel may recommend that lethal methods be used initially to resolve the immediate problem while non-lethal methods are implemented, such as fence construction.

Non-lethal methods used or recommended by WS-New Mexico may include habitat management, husbandry, hazing, fencing, aversive/harassment devices, herding, and livestock guard animals (Appendix A). WS-New Mexico may occasionally loan equipment such as propane cannons and pyrotechnics to livestock producers. In many situations, the implementation of non-lethal methods, such as construction of fencing, is the responsibility of the requestor to implement. Many of these methods require regular maintenance and/or human presence to be effective. For dispersing predators, the proper timing is essential. Using methods soon after damage begins or soon after threats are identified increases the likelihood of success.

In most situations, a cooperating entity has already tried reasonable non-lethal methods to resolve damage prior to contacting WS-New Mexico for assistance. In those cases, the methods used by the requester were either unsuccessful or the reduction in damage or threats had not reached a level that was tolerable to the requesting entity. In those situations, WS-New Mexico could use other non-lethal methods, attempt to continue the use of the same non-lethal methods, and/or recommend or use lethal methods.

- **Lethal methods**

After receiving a request for assistance and conducting a field review, trained and certified WS-New Mexico personnel may determine that lethal methods are appropriate. Lethal methods are often used to reinforce non-lethal methods, to remove animals that have been identified as causing damage or posing a threat to human safety, and/or to reduce the risk of depredation reoccurring in an area where it has occurred in the past. The use of lethal methods results in temporary and small local reductions of the numbers of predators in the area where damage or threats are occurring or are expected to reoccur. The number of animals removed from the area using lethal methods under this alternative is dependent on the number of predators involved with the associated damage or threat, the potential for reoccurrence of depredation, especially on livestock or ESA-listed species, and the effectiveness of methods used.

Lethal methods used by WS-New Mexico employees include ground shooting, aerial shooting, snaring, live trapping, such as using snares, nets, cage traps, and foothold traps (followed by mechanical or chemical euthanasia) or methods such as chemical toxicants when lawful. These methods are described in detail in Appendix A. WS-New Mexico employees follow the American Veterinary Medical Association (AVMA 2013) euthanasia recommendations for free-roaming and captured animals in program activities, BMPs for trapping furbearers (White et al 2020), (APHIS-WS Directive 2.505, and Sections 2.4, 3.9, and 3.10.3.3), and use the most humane and rapid methods available under the circumstances and per the APHIS-WS Decision Model (Sections 2.3.1.2, Appendix A, and Section 3.9).

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

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

WS-New Mexico conducted aerial shooting in a portion of 27 counties between FY 2015 and FY 2019. Aerial shooting occurs only on lands where it is authorized and when under agreement, primarily on private lands. Aerial operations conducted by New Mexico WS are minor in terms of geographic scope because 94% of the land area in New Mexico is not exposed to any such activity. Of the total hours WS flew 74% on private and state lands, 12% on BLM lands, 6% on tribal lands, 7% on USFS lands, and 1% on all other lands (MIS 2021).

Aerial shooting can also be conducted by other entities under permit from the NMDGF to remove coyotes for livestock protection (Section 1.7).

Senate Bill 32 (section 2.4.4.7) restrictions on WS-New Mexico PDM methods on public Land.

Neck Snares:

Between FY15 and FY19, WS captured an average of 582 animals per year via neck snares. Approximately 64% of statewide take by neck snare occurred on Private land, 27% on State Land, and the remaining percentage was shared between BLM, Military, and Tribal lands. Senate Bill 32 restricts neck snares from being set on all public lands, so it is expected that the use of other legal methods such as firearms and foothold traps will increase on State and Federal lands. A breakdown of species take by PDM component can be found on Table 2.1 and in Appendix D.

M-44:

From FY15 to FY19, WS took an average of 689 animals per year using M44's. Approximately 59% of statewide take by M44 occurred on Private Land, 35% on State Land, and the remaining 5.5% occurred on BLM land. SB32 will restrict M44 use on public lands, so it is expected that the use of other legal PDM methods, such as firearms and foothold traps, will increase on public lands. A breakdown of species take by PDM component can be found on Table 2.1 and in Appendix D.

LPC:

Livestock Protection Collars account for only 0.05% of the total WS-New Mexico annual coyote take (average less than 2 coyote per year) from WS FY 2015 through FY 2019. Restriction of this method on public land will have minimal impact to WS PDM in New Mexico.

Any strategy involving reducing the number of predators in a particular area during a regulated hunting/trapping season is the responsibility of NMDGF as authorized by state law.

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

Some methods may be part of either a lethal or non-lethal strategy, or a combination of both. For example, foothold and cage traps may be used to capture animals for relocation or for euthanasia upon capture, depending on the circumstances, species, policy and regulatory requirements, and management objective. As described in Section 1.7, NMDGF discourages relocating certain species of predators, such as coyotes, skunks and raccoons, and predators that have a risk of continuing the problem in their new location, may spread disease, or not fare well due to intraspecies competition. APHIS-WS policy also discourages relocation of captured offending predatory animals for the same reason (APHIS-WS Directive 2.501; Section 2.4). The American Veterinary Medical Association, the National Association of State Public Health Veterinarians and the Council of State and Territorial Epidemiologists also oppose relocation of captured problem animals because of the risk of disease transmission among wild mammals. Therefore, many animals captured using non-lethal methods are often euthanized per state and APHIS-WS policy.

- **Minimization Measures**

See Section 2.4 for list of protective measures, including APHIS-WS Directives, state law and regulation, ESA terms and conditions and measures pertinent to this alternative. Table 2.1 summarizes the proportion of WS-New Mexico annual intentional predator take by method (Section 3.5, Table E.1) and Table 2.2 summarizes the annual intentional predator take by land class. Most predators intentionally taken by WS-New Mexico during PDM activities occur on private land, and most of those are coyotes.

Table 2.1. WS-New Mexico Proportion of Intentional Lethal Take of Predators by Method, 2015-2019[1].

Common Name	Trap/ Snare	M-44	Aerial Shooting	Firearms	Livestock Protection Collar
Coyote	22.4%	26.73%	21.43%	29.35%	0.05%
Black bear	100%	0	0	0	0
Striped skunk	94.64%	0	0	5.36%	0
Raccoon	25%	0	0	75%	0
Cougar	41.18%	0	0	58.82%	0
Bobcat	46.16%	0	7.69%	46.15%	0
Badger	81.82%	0	0	18.18%	0
Gray Fox	35.71%	0	0	64.29%	0

[1] Difference between calculated proportion and 100% due to rounding.

Table 2.2. Proportion of Intentional Take of Predator Species by WS-New Mexico during PDM Activities Occurring on Each Land Class, FY 2015- FY 2019.

Species (Total WS-New Mexico 5-year Intentional Take)	Private and State	BLM	Forest Service	County/ City	Military	Tribal	% Total Predator Intentional Take by Species
Coyote (18,886)	89.6%	8.97%	0.71%	0.12%	0.26%	0.36%	89.05%
Black Bear (17)	80%	0	20%	0	0	0	<0.1%
Striped Skunk (2,929)	98.84%	0	0	1.13%	0.04%	0	10.21%
Raccoon (5)	100%	0	0	0	0	0	<0.1%
Cougar (31)	84.6%	0	7.7%	0	0	7.7%	0.1%
Badger (14)	88.24%	0	0	0	11.76%	0	<0.1%
Bobcat (80)	83.7%	14.13%	0	0	2.17%	0	0.37%
Gray Fox (9)	72.22%	0	0	22.22%	5.6%	0	<0.1%
% Total Predator Intentional Take by Land Class	86.91%	3.37%	0.54%	1.99%	7%	0.19%	

2.3.1.9 What is involved in management of wildlife hazards to aircraft and air passengers?

Upon receiving a request for assistance for PDM from an airport authority, WS-New Mexico can provide a variety of services, including assessing the situation, developing an operational plan, and assisting with implementing the plan. WS-New Mexico may identify and evaluate hazards to aircraft and operations due to problematic predators present and when requested prepares a Wildlife Hazard Assessment. WS-New Mexico may assist the airport in developing a Wildlife Hazard Management Plan to address those hazards and threats or be requested to assist airports in implementing an existing management plan. The Wildlife Hazard Management Plan may be combined with recommendations for resolving hazard threats caused by all wildlife species at airports. However, while aviation hazards caused by predators are included in this EA, avian hazards are outside the scope of this EA and are covered by the New Mexico Bird Damage Management EA.

Direct operational activities consist of various harassment, live-capture, and lethal removal techniques aimed at removing mammalian predators causing hazards. WS-New Mexico personnel also provide ongoing technical advice to airport managers regarding methodologies to reduce the presence of wildlife in areas of operations within airports, including providing technical advice on various habitat management projects that could be implemented by airport personnel. In addition, WS-New Mexico promotes improved wildlife strike hazards recordkeeping, provides predator identification services (such as collecting evidence such as feathers or fur, which may be all that is remaining after a strike), and monitors animal numbers at participating airports to assist in developing an effective predator damage management program.

2.3.1.10 What other entities conduct PDM in the absence of WS-New Mexico?

As defined by the 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). The Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" (Question 3; https://ceq.doe.gov/nepa/regs/40/40p3.htm), states:

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

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

State agencies also have legal authority to respond to and manage wildlife conflicts. As discussed in Section 1.7, NMDGF and NMDA have legal wildlife damage management authority, and NMDGF can issue depredation permits and permits for aerial shooting. For predators not managed as game or furbearer mammals in New Mexico, property owners can also remove such animals causing depredation or damage with a permit issued by NMDGF or without a permit, depending on the species (Section 2.4.4.1). In addition, NMDGF can set take limits for game and furbearer predators during hunting and trapping seasons to manage population levels to meet state objectives, which may include for protecting game species in specific wildlife management units (Section 1.7). Local authorities are primarily involved with complaints regarding feral/free-ranging dogs and cats.

Given that federal, state, commercial, and private entities receive authorization to conduct predator damage management from the NMDGF and the NMDA, and that most methods for resolving predator damage are available to both WS-New Mexico and to non-federal entities, it is clear that, even under all the alternatives, including those in which WS-New Mexico is not involved with direct (lethal) PDM, other entities are and will continue to conduct PDM (Sections 2.3.1.11 and 3.4).

All non-lethal methods and most lethal methods are available to non-WS-New Mexico entities. In New Mexico, both NM WS and certified private pesticide applicators may use M-44s. M-44s are commonly used by NM WS staff (average 1,066 coyotes per year, with approximately 23.8% of total annual coyote take by WS FY 2015 through FY 2019 (MIS 2020).

2.3.2 Alternative 2: WS-New Mexico provides lethal and non-lethal technical assistance and only non-lethal preventive and corrective operational assistance.

WS-New Mexico would provide technical assistance, providing both non-lethal and lethal recommendations, advice, and information for others to implement, and would provide assistance to implement non-lethal PDM activities. Under this alternative, WS-New Mexico personnel would not operationally use lethal PDM methods.

This is similar to Alternative 1 (Proposed Action/No Action) except that WS-New Mexico field personnel would not be available to directly provide lethal PDM to any requester, even if contracted as an agent of NMDGF. Requestors would be dependent on assistance from commercial companies, pilots with state aerial depredation permits, NMDGF or their agents, or volunteers for their lethal PDM responses, or conduct the actions themselves, as allowed by state law (Sections 1.7 and 2.3.1).

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

Under this alternative, WS-New Mexico could recommend any of the lethal and non-lethal technical assistance methods discussed in Appendix A to assist cooperators using an integrated wildlife management approach. WS-New Mexico employees would provide technical information, demonstrations and training, and operational assistance on non-lethal management methods to entities requesting assistance, such as use of guard dogs, frightening devices, chemical repellents, harassment, fencing, exclusion, animal husbandry, modification of human behavior, habitat modification, and cage traps, and immobilization and relocation where relocation would be permissible by state law and state and APHIS-WS policy. WS-New Mexico may also recommend that property owners or managers allow predators to be harvested during the regulated hunting and/or trapping season for those species in an attempt to reduce the number of animals causing damage on their properties. Establishing hunting and trapping seasons and the allowed harvest during those seasons is the responsibility of the NMDGF. This alternative places the immediate burden of operational damage management work and any environmental compliance responsibilities on the resource owner, other governmental agencies, and/or private businesses.

WS-New Mexico may provide supplies or materials to requesters for implementation of non-lethal methods that are of limited availability for use by private entities, such as loaning high-powered flashlights and predator calls. Generally, under this alternative, WS-New Mexico could recommend several non-lethal management strategies (Appendix A) to the requester for short-term and long-term solutions to managing damage, as well as recommend and provide training on lethal techniques. Those persons receiving technical assistance from WS-New Mexico could implement recommended methods, use other lethal and non-lethal methods not recommended by WS-New Mexico, seek assistance from other entities, or take no further action. While WS-New Mexico could recommend non-lethal and lethal methods, WS-New Mexico would only loan equipment or implement those non- lethal methods legally available for use by the requester and advise them of any permits needed.

WS-New Mexico would have no legal responsibility for any lethal and non-lethal actions implemented by requester. The requester is responsible for compliance with the Endangered Species Act and state laws and regulations.

Between FY2015 and FY2019, WS-New Mexico conducted 1,442 technical assistance projects that involved wildlife damage to agricultural resources, property, natural resources, and threats to human safety caused by predator species covered in this EA.

2.3.3 Alternative 3: WS-New Mexico provides non-lethal PDM assistance before lethal assistance.

Under Alternative 3, WS-New Mexico would provide both non-lethal and lethal technical and operational assistance to requesting cooperators, similar to Alternative 1. However, reasonable non-lethal methods would have to be shown ineffective to resolve the damage or threat before WS-New Mexico could take lethal action, regardless of the results of the strategies determined to be effective based on use of the APHIS-WS Decision Model. WS-New Mexico would use non-lethal methods first in response to every request for assistance regardless of severity, intensity, and immediacy of the damage or threat or the results of application of the APHIS-WS Decision Model.

Depredation from previous years or seasons could not be used as a reason for applying proactive lethal management. Lethal operational assistance could not be taken until WS-New Mexico had confirmed and recorded that reasonable non-lethal actions had not resolved the problem, that the problem is ongoing, and that lethal methods would effectively address the depredation. The definition of "reasonable" is determined in the field by the WS-New Mexico employee in coordination with the cooperator, but it must include consideration of the specific circumstances (for example, building anti-predator fence around a large pasture is most likely not "reasonable", but it would be reasonable around a smaller holding area), conditions (for example, weather, proximity to residences, access by the public), or exorbitant costs.

Non-lethal and lethal technical assistance would continue to be used as described in Alternative 1.

This alternative requires that:

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

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

WS-New Mexico would not provide preventive lethal PDM assistance, and lethal PDM assistance could not be taken until WS-New Mexico has confirmed and recorded that reasonable non-lethal actions have not resolved the problem.

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

See Section 2.5.7 for list of minimization measures, including APHIS-WS Directives, state law and regulation, ESA terms and conditions and measures pertinent to this alternative.

2.3.4 Alternative 4: WS-New Mexico provides lethal PDM only for human/pet safety or to protect ESA listed species.

Under this alternative, WS-New Mexico would provide full PDM technical assistance, including providing recommendations and guidance to the requester on implementation of lethal and non- lethal PDM methods, and provide non-lethal operational PDM, but would only provide lethal operational PDM assistance for protecting human/pet health or safety or to protect ESA-listed species. For instances of human/pet health or safety or to protect ESA-listed species, all lethal and non-lethal PDM methods described in Appendix A of the EA are available for recommendation and/or use. WS-New Mexico would respond to all other requests for PDM assistance with non-lethal operational methods and lethal and non-lethal technical assistance.

See Section 2.4 for list of protective measures, including APHIS-WS Directives, state law and regulation, ESA terms and conditions and measures pertinent to this alternative.

2.3.5 Alternative 5: No WS-New Mexico involvement in PDM activities.

WS-New Mexico would not be involved in any predator damage management efforts in New Mexico. PDM would still be implemented by other legally-authorized entities, such as NMDGF, NMDA, property owners, commercial PDM companies, NMDGF-authorized pilots, and NMDGF volunteers (Sections 1.7 and 2.3.1). Entities experiencing damage caused by predators could continue to resolve damage by employing all methods legally available, since the removal of predators to alleviate damage or threats would occur despite the lack of involvement by WS-New Mexico.

Currently, NMDGF provides direct wildlife damage management assistance for protected game and furbearer species and provides technical assistance and issues depredation permits for such activities as appropriate and within available resources. Requests for PDM information directed to WS-New Mexico would be redirected to NMDGF.

Requesters would need to seek information on existing and new PDM methods (including methods developed and tested by the APHIS-WS NWRC) from sources such as NMDGF, NMDA, University of New Mexico Extension Service offices, conservation districts, or pest control companies. Also, private individuals and companies are not obligated to conduct any NEPA analyses, engage in consultations under the ESA, or conduct formal monitoring.

2.4 WHAT ARE THE PROTECTIVE MEASURES INCLUDING POLICIES, CONSULTATION MEASURES AND STATE LAWS THE WS-NEW MEXICO IMPLEMENTS TO AVOIDS OR REDUCE ADVERSE EFFECTS.

The measures listed in this section improve the safety, selectivity, and efficacy of PDM activities, and reduce or eliminate unwanted environmental effects. WS-New Mexico incorporates these measures into the current program, and these measures would be incorporated into any other alternative in which some level of operational WS-New Mexico activities would occur (Alternatives 1, 2, 3, and 4). For example, APHIS-WS policies involving lethal take included in its directives would not apply to alternatives in which WS-New Mexico would not take lethal action, although the agency could recommend such actions under technical assistance.

While the following measures are implemented by WS-New Mexico, not all procedures pertain to the prevention or minimization of environmental impacts, such as personnel safety procedures for firearms. However, all the measures included in this section address issues considered in detail in Chapter 3.

The measures in this section are organized into four major parts:

- APHIS-WS policies included in formal directives, categorized by topic
- WS-New Mexico formal and informal consultations with the USFWS
- Additional measures
- Relevant State of New Mexico laws and regulations

2.4.1 APHIS-WS policies in formal directives

2.4.1.1

WS Directive 2.101: Preference for Non-Lethal Methods When Appropriate
WS Directive 4.130: Requests for Assistance
WS Direct 1.210: Compliance with Federal, State, and Local Laws and Regulations

a.	*Technical and direct control assistance may involve the use of either lethal or non-lethal methods, or a combination of the two. Preference is given to non-lethal methods when practical and effective.* (WS Directive 2.101)
b.	*Wildlife damage management services are provided only in response to requests for assistance.* (WS Directive 2.201)
c	*All employees (Federal and non-Federal) are responsible for conducting official duties in compliance with all Federal laws, and also applicable State and local laws that do not directly and substantively conflict with and frustrate WS' Federal statutory authorities. In a situation requiring a variance from a State of local law or regulations that does not directly and substantively conflict with and frustrate WS Federal statutory authorities, either a State or local authority agrees to carry out the action in cooperation with WS or a written authorization or concurrence must be obtained from the appropriate State or local authority.* (WS Directive 2.210)

2.4.1.2. APHIS-WS Policies Regarding Capture Devices

WS Directive 2.450: Traps and Trapping Devices

a.	*All employees whose duties involve animal capture should participate in a WS approved trapper education course as recommended by Best Management Practices guidelines. State Directors may provide for continuing trapping education for appropriate employees at district, state, or regional meetings.*
b.	*Use of all traps, snares (cable device), and other animal capture devices by WS employees will comply with applicable federal, state, and local laws and regulations related to animal capture for managing wildlife damage.* [also WS Directive 2.210 "Compliance with Federal, State, and Local Laws and Regulations." (Appendix B)]
c.	*All traps and trapping devices will be set in a manner which minimizes the chances of*

	capturing non-target species. If possible, non-target animals that are captured will be released.
d.	*If an animal that appears to be a licensed pet is captured, reasonable efforts will be made to notify the owner, seek veterinary care if necessary, or deliver the animal to appropriate local authorities.*
e.	*Animals targeted for lethal control in direct control projects will be dispatched immediately, removed from capture devices, and properly disposed (also WS Directives 2.205 "Euthanizing Wildlife"* [Section 2.4.1.9 below], 2.510 "Fur, Other Animal Parts and Edible Meat", and 2.515 "Disposal of Wildlife Carcasses" [Part 2.4.1.8 below])
f.	*Captured animals intended for release, relocation, or captivity will be handled and transported appropriately to achieve project objectives* (also WS Directive 2.501 *"Translocation of Wildlife"*)
g.	*Foot-hold traps or snares are not to be set closer than 30 feet from any exposed animal carcass or part thereof, having meat or viscera attached, including remains of animals previously removed from traps or snares (cable device) that may attract raptors or other non-target animals. If an animal carcass could be dragged or moved by scavengers to within 30 feet of set foot-hold traps, snares (cable device), the carcass will be secured to restrict movement* (also WS Directive 2.455, *"Scents, Baits, and Attractants"*). *These restrictions do not apply to animal carcasses used to attract bear or mountain lion to approved capture devices.*
h.	*The use of foot-hold traps and spring activated leg snares (cable device) must incorporate pan-tension devices as appropriate to prevent or reduce the capture of non-target animals, unless such use would preclude capture of the intended target animals.*
i.	*Foot-hold traps with inside jaw spread greater than 5 ½ inches, when used in restraining sets, are limited to types with smooth, offset jaws that may or may not be laminated or to padded-type jaws. Foot-hold traps with teeth or spiked jaws are prohibited. WS Regional Director may authorize use of modified jaw protrusions on traps for the purpose of reducing injuries to target animals.*
j.	*If it is necessary to use foot-hold traps or snares (cable device) under fence lines, reasonable efforts to be taken to obtain approval from adjacent landowners where applicable; judgment should be used to avoid capture of livestock and other domestic animals.*
k.	*The use of break-away locks or stops is encouraged when livestock, deer, or other large animals may be exposed to snare (cable device) sets.*
l.	*Capture devices should be set to minimize visibility of captured animals.*
m.	*Foot-hold traps (long-spring or coil spring) will not be used to take bear.*

2.4.1.3 Use of Firearms

WS Directive 2.615: WS Firearm Use and Safety

a.	All WS-New Mexico use, storage, and transportation of explosives will be in compliance with applicable Federal, state, and local laws and regulations, employees will be trained and certified per WS Directive 2.615 "Firearms Use and Safety" and WS Directive 2.625 "Pyrotechnics, Rocket Net Charges and Incidental Explosive Materials" and its Attachment 1 for safe and secure storage and transportation of the materials.
b.	*Shooting a firearm, projectile or pyrotechnic out of a vehicle is permitted as long as the firearm or device is not loaded (a cartridge in the chamber) until the muzzle is safely out of the window of the vehicle and a clear line of fire is established. The muzzle of the firearm or device may not be retrieved back into the vehicle until the device has no live round in the chamber.*

c.	*Whether a firearm is being stored in an office, vehicle, home, camp, or any other location, the maximum level of security available should be employed. Security devices may range from gun safes, vaults, locking gun racks, to cables through the receiver or frame opening locked to an immovable object.* All firearm storage will be per this Directive.
d.	*All WS personnel, regardless of employment status, and official volunteers who are required or requested to use firearms in the conduct of official duties must adhere to all basic rules of firearm safety, and will be provided firearm safety and handling training per the WS Firearms Safety Training Manual. Aerial crewmember training will consist of instruction from the WS Firearm Safety Training Manual as well as additional specialized instruction that may be contained in the WS Aviation Operations Manual, the WS Aviation Safety Program Manual, and the WS Aerial Operation Crew Member Training Manual.*

2.4.1.4. Use of Explosive Materials

WS Directive 2.625: Pyrotechnics, Rocket Net Charges, and Incidental Explosive Materials

a.	*All WS use, storage, and transportation of explosives will be in compliance with applicable Federal, state, and local laws and regulations. Employees assigned to use pyrotechnic pistols or other launching devices will receive safety training in their use as required by WS Directive 2.615 "Firearms Use and Safety."*
b.	All storage and transportation of pyrotechnics, rocket net charges and incidental explosive materials will be conducted per the standards in Attachment 1 of WS Directive 2.625.
c.	*All WS use, storage, and transportation of explosives will be in compliance with applicable Federal, state, and local laws and regulations. Employees assigned to use pyrotechnic pistols or other launching devices will receive safety training in their use as required by WS Directive 2.615 "Firearms Use and Safety."*
d.	All storage and transportation of pyrotechnics, rocket net charges and incidental explosive materials will be conducted per the standards in Attachment 1 of WS Directive 2.625.
e.	*All WS use, storage, and transportation of explosives will be in compliance with applicable Federal, state, and local laws and regulations. Employees assigned to use pyrotechnic pistols or other launching devices will receive safety training in their use as required by WS Directive 2.615 "Firearms Use and Safety."*

1.4.1.5 Use Hazardous Materials and Pesticides

WS Directive 2.465: Accountability and Oversight of Hazardous Materials and Pesticide Use
WS Directive 2.401: Pesticide Use

a.	*During the fiscal year, at least one annual physical inventory will be conducted by the hazardous material user and one reviewing official (i.e., District Supervisor, Assistance District Supervisor, collateral duty safety officer) designated by the State Director. All hazardous materials discrepancies will be resolved by the pesticide user and/or the reviewing official at the time of the physical inventory, if possible. All discrepancies will be corrected in the MIS CMITS database within 30 days. Some of the subject matter that will be reviewed regarding hazardous materials is as follows: security, storage, warning signs, inventory, receipt and transfer of documentation, handling, disposal of pesticides, I&E [immobilization and euthanasia] drugs, pyrotechnics, etc.* (WS Directive 2.465)
b.	*WS activities will be in compliance with applicable Federal, State, Tribal, and local laws and regulations pertaining to pesticides, including application, certification, storage, transportation, shipment, disposal, and supervision, or when recommending the use of restricted-use pesticides. Restricted use pesticides used or recommended by WS personnel must be registered by the US Environmental Protection Agency (EPA) and the appropriate State regulatory agency.* (WS Directive 2.401)

c.	*For field applications, where other decontamination equipment of sufficient quantity and type is not readily available, WS personnel must carry a decontamination kit containing at least one quart of water, coveralls, disposal towels, and soap. Incidents and/or accidents resulting from the use of pesticides must be immediately reported to the appropriate supervisor and the WS Safety and Health Council. The WS Safety and Health Council is responsible to investigate and/or coordinate the investigation of any incident or accident related to the use of pesticides. WS personnel are required to report to the State Director, any knowledge of adverse incidents involving APHIS registered products.* (WS Directive 2.401)
d.	All storage, transportation, inspections, training, and emergency procedures will be conducted according to WS Directive 2.401 Attachment 1. (WS Directive 2.401)

2.4.1.6. Use of M-44s

WS Directive 2.415 M-44: Use and Restrictions

Implementation Guidelines for 27 Use Restrictions

EPA Use Restrictions (as written on Label)	WS Implementation Guideline
1. Use of the M-44 device must conform to all applicable Federal, State, and local laws and regulations.	State Directors are responsible for ensuring that employees under their supervision are fully aware of all relevant federal, state, and local laws and regulations, and individual M-44 applicators are responsible for complying with these laws and regulations. Applicable laws will vary from state to state, as well as within states. WS M-44 applicators are subject to inspection by EPA or state regulatory enforcement officials to ensure compliance with applicable laws and regulations. State Directors and subordinate supervisors must ensure that all M-44 use by personnel under their jurisdiction complies with the National Environmental Policy Act (NEPA), the Endangered Species Act, and applicable documents and decisions, agreements, and federal agency work plans. *Note: Its is unlawful to set M-44s on public land in New Mexico. See Senate Bill 32 (Section 2.4.4.7)

2. Applicators must be subject to such other regulations and restrictions as may be prescribed from time-to-time by the U.S. Environmental Protection Agency (EPA).	Additional regulations and restrictions prescribed by EPA will be provided by the WS Operational Support Staff through normal supervisory channels. Each State Director is responsible to ensure that all M-44 applicators in the state under their supervision are properly trained and individual M-44 applicators are responsible for complying with all Federal and State regulations regarding M-44 use.
3. Each applicator of the M-44 device must be trained in: (1) safe handling of the capsules and device, (2) proper placement of the device, and (3) necessary record keeping.	Applicators of pesticides must be trained and certified by the appropriate state regulatory agency. State regulatory agency training meets WS requirements if it includes specific M-44 requirements regarding use, safety precautions, and record keeping. In those states where generalized pesticide training lacks specific M-44 training, the State Director must supplement the training to meet specific training needs on use, safety precautions, and record keeping requirements. WS State Directors must ensure that all M-44 applicators they supervise are adequately trained and certified as often as the state pesticide agency requires. Supervisors must use the "Annual M-44 Sodium Cyanide Training Certification" form (WS Form 40) to document applicator knowledge during annual field inspections. In addition, supervisors are required to conduct and document at least one annual field inspection regarding the use of M-44's, Use Restriction #17.
4. M-44 devices and sodium cyanide capsules must not be sold or transferred to, or entrusted to the care of any person not supervised or monitored by the Animal and Plant Health Inspection Service (APHIS), Wildlife Services (WS) or any agency not working under a WS cooperative agreement.	M-44 cyanide capsules and ejectors will be used only by staff under the supervision of the WS State Director who are Certified Applicators, and who have received specific M-44 training as described in Use Restriction #3. Those personnel will transfer M- 44 capsules or equipment only to other staff who are certified M-44 applicators. When transfer of sodium cyanide is necessary, the capsules shall be tracked using the WS Controlled Materials Inventory Tracking System (CMITS).

5. The M-44 device must only be used to take wild canids: (1) suspected of preying on livestock or poultry; (2) suspected of preying on Federally designated threatened or endangered species; or (3) that are vectors of a communicable disease.	M-44s may not be used to protect wildlife other than Federally designated threatened or endangered species. "Livestock or poultry" includes the species listed in "Livestock" and "Commercial Game Animals (Pen- raised)" subcategories of the "Management Information System" (MIS) Resources Protected codes. "Wild canids" for which M-44s may be used include coyote, red fox, gray fox, and wild (feral) dogs (see label and WS Directive 2.340 "Feral, Free Ranging, and Hybrid Dog Damage Management"), subject to further restrictions by state or local regulations. States can restrict but cannot expand the list of

UR #5 Continued.	approved target species. Only EPA can designate additional target species.
6. The M-44 device must not be used solely to take animals for the value of their fur.	This restriction reinforces long-standing WS policy prohibiting the taking of animals solely for the value of their fur by M-44s or any other method.
7. The M-44 device must only be used on or within 7 miles of a ranch unit or allotment where losses due to predation by wild canids are occurring or where losses can be reasonably expected to occur based upon recurrent prior experience of predation on the ranch unit or allotment. Full documentation of livestock depredation, including evidence that such losses were caused by wild canids, will be required before applications of the M-44 are undertaken. This use restriction is not applicable when wild canids are controlled to protect Federally designated threatened or endangered species or are vectors of a communicable disease.	The 7-mile rule applies only to M-44 use for the protection of livestock or poultry. "Recurrent prior experience of predation on the ranch unit or allotment" means a history of predation that has been documented in MIS records. MIS documentation of reported or confirmed livestock or poultry losses, on a MIS Direct Control Work Task or a MIS Technical Assistance Work Task, constitutes "full documentation of livestock depredations, including evidence that losses were caused by wild canids." Personnel will 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, manager, or lessee or in compliance with applicable Memoranda of Understanding with public land management agencies. M-44 use must be specifically authorized through a signed written agreement or through provisions in work plans with cooperating agencies. Each Specialist is responsible for determining the boundaries of properties covered by control agreements, and to place M-44s only where authorized by the agreement.
8. The M-44 device must not be used: (1) on Federal lands set aside for recreational use, (2) in areas where exposure to the public and family or pets is probable, (3) in prairie dog towns, or (4) in National or State Parks; National or State Monuments; federally designated wilderness areas; and wildlife refuge areas, except that the M-44 device may be	(1) Use of M-44s is prohibited on federal lands, in areas specifically designated for recreational use. M-44 non-use areas on public lands will be identified through interagency consultations at the WS State Office or District Office level. These areas are oftentimes specifically identified on public maps; such non-use areas will include beaches, campgrounds, and locations where specific seasonal recreation use occurs. (2) Compliance with this rule requires common sense and good judgment, as well as input from local sources regarding public use and seasonal variations in such

used in the areas listed above in (4) only for the protection of Federally designated threatened or endangered species. **To determine whether the applicable land management agency has set aside any area on Federal Lands for recreational use either on a permanent or temporary basis, the APHIS State Director or his/her designated representative who are considering authorizing or are responsible for ongoing use of M-44 capsules on public lands, must contact each applicable land management agency quarterly to determine whether any portions of the projected or current M-44 use areas are, or are to be, set aside for recreational use. Within 30- days of that contact, the APHIS State Director, or his/her designated representative, must provide the applicable land management agency with written documentation specifying the applicable land management agency's determinations of what projected or current M-44 use areas are to be set aside for recreational use. For purposes of this Use Restriction, areas set aside for recreational use include areas where and when there are scheduled recreational events, areas identified on maps with "recreation" in the title, areas where developed or known camping occurs, areas near**	use. Regardless of any other consideration, every effort will be made to avoid areas of heavy public use and public exposure. (3) The exclusion of M-44s from prairie dog towns is intended to protect black-footed ferrets. Consultations are not needed for types of lands where M- 44s will never be used; see list in Use Restriction #8, item (4). "Wildlife refuge areas" means officially designated Federal or State wildlife refuges or wildlife management areas that are identified by appropriate signs and maps. WS will coordinate quarterly with the land management agency to determine recreational areas where M-44s may not be set. These quarterly contacts can be made through work plan meetings, telephone conversations, in person, or email. Within 30 days after each quarterly contact, WS must 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-44s and unscheduled events that were not planned or discussed during the annual work plan meetings. For WS offices with no plans for use of M- 44s on public lands, quarterly contacts are not necessary. Prior to placement of M-44s on any federal lands, WS must ensure compliance with any Pesticide Use requirements of the land management agency.

designated or known recreational trail heads and designated or known vehicle access sites.	This space intentionally left blank.
9. The M-44 device must not be used in areas where federally listed threatened or endangered animal species might be adversely affected. Each applicator must be issued a map, prepared by or in consultation with the U.S. Fish and Wildlife Service, which clearly indicates such areas. **(1) Except as provided in paragraph (2) below, the M-44 device must not be used in areas occupied by any federally listed threatened or endangered species or any federally listed experimental populations as set forth in the most current versions of maps that have been prepared or approved by the U.S. Fish and Wildlife Service (FWS). At the time of application, the applicator must be in possession of the most current map, if such map exists, that covers the application site. If maps covering the application site do not exist, then the M-44 applicator must, prior to application, consult with FWS to determine whether the application site is in an area occupied by listed animal species. Any use of the M-44 thereafter must be consistent with any conditions or**	Personnel will use all control methods, including M- 44s, in ways that minimize adverse impacts to non- target animals and the environment, and will conduct Section 7 consultations with U.S. Fish and Wildlife Service (USFWS), as required. Before placing M-44s (see the label), applicators will consider impacts on state-listed species and federal and state species that are candidates for listing. Maps for listed threatened and endangered species or experimental populations will be obtained by each State Director from appropriate FWS Endangered Species resources, including personnel and/or on-line planning tools such as IPaC (https://ecos.fws.gov/ipac/). Alternatively, maps may be prepared jointly by WS and FWS personnel. Where FWS personnel are unavailable or unable to cooperate in this activity, the State Director will prepare appropriate maps and will provide copies to FWS Endangered Species and State wildlife agency offices whenever new or updated maps are distributed to M-44 applicators. Each applicator must be aware of specific areas closed to M-44 use, as shown in "Endangered Species Considerations" on the label. Endangered species maps are not needed in states or areas where no vulnerable threatened or endangered species exist, as determined by informal consultations between WS and federal and/or state endangered species offices.

limitations provided by FWS through such consultation. **(2) Notwithstanding paragraph (1), the M-44 device may be used in areas occupied by endangered, threatened, or experimental populations if use in such areas a) has been addressed by FWS in special regulations pursuant to section 4(d) of the ESA, in requirements imposed through incidental take statements or incidental take permits, or in other applicable agreements with the FWS, and** **b) the applicator's use of the M- 44 is consistent with any conditions or limitations provided by FWS for such use.**	This space intentionally left blank.
10. At least one person within APHIS in addition to the individual applicator must have knowledge of the exact placement of all M-44 devices in the field. This includes initial placement and any subsequent changes of M-44 GPS locations as soon as possible but no later than 14 days. In the case of applications to privately owned land, the applicator must also have written permission from the landowner or lessee who has requested M-44 device use prior to their placement. When devices are placed on private land, all residences on the property must be notified of the M-44 device use.	Applicators will meet this requirement by providing their supervisors with electronic or hard copies of M-44 GPS locations including the initial placement and any subsequent changes as soon as possible, but no later than 14 days after placement. No one in addition to the certified applicator need be present during placement or replacement of M-44 devices, but at least one person within APHIS, in addition to the individual applicator must have knowledge of the exact placement of all M- 44 devices in the field. In the case of applications to privately owned land, prior to placing an M-44 device, the applicator must also have written permission from the landowner, manager or lessee who has requested M-44 device use prior to their placement. A Work Initiation Document (WID) that authorizes the use of M-44s and is signed by the cooperator satisfies this requirement. When devices are placed on private land, the applicator must notify all residences on the property of the M-44 device use.

11. In areas where more than one governmental agency is authorized to place M-44 devices, the agencies must exchange placement information and other relevant facts to ensure that the maximum number of M-44s allowed is not exceeded.	As a general policy, WS will not use M-44s on any property where persons other than personnel under the direction of the State Director are using them. Each exception to this rule must be authorized in writing by the supervisor or State Director before any M-44s are set. In such exceptional cases where WS and other governmental agencies or private individuals are using M-44s concurrently, personnel will communicate with other users sufficiently to ensure that the maximum number of M-44s placed by all users does not exceed the totals set forth in Use Restrictions #15 and #16.
12. The M-44 device must not be placed within 200 feet of any nonfrozen lake, stream, or other body of water, provided that natural depression areas which catch and hold rainfall for short periods of time shall not be considered "bodies of water" for purposes of this restriction. M- 44 devices may be set within 200 feet of frozen bodies of water only if (i) they are removed before the water body is no longer completely frozen, and (ii) are set at such elevation to prevent inundation in the event of an untimely thaw.	Dry irrigation ditches, water troughs, and completely frozen lakes, ponds, and streams are not "bodies of water" for purposes of this Use Restriction. Avoidance of hazard to humans and non-target animals may require at times that M-44 sets be more than 200 feet away from water. Wherever uncertainty exists about the suitability of specific placement locations, applicators should consult with their supervisors before placing M-44s. (See Use Restriction #14).
13. The M-44 device must not be placed in areas where food crops are planted.	This use restriction is intended to protect people who work in fields where crops are planted as well as people who consume the food products from the fields. This Use Restriction does not prohibit the placement of M-44s in: (i) areas adjacent to food crop fields; or (ii) in fields where food crops have been completely harvested, provided that M-44s are removed prior to replanting.

14. The M-44 device must not be placed within 300 feet of any designated public road or public pathway.	Applicators must not set M-44s closer than 300 feet to a designated public road or public pathway. "Public road or public pathway" generally means a road or trail that is designated and identified as such on maps, is open to unrestricted public access and is maintained by a government or public entity. A pickup track or livestock path is not a "designated public road or public pathway" for purposes of this use restriction. Any uncertainty about specific public roads or pathways on public lands should be resolved through informal consultation with local land management agency personnel. Personnel will not place M-44s in any location where exposure to the public and family pets is probable (Use Restriction #8).
15. The maximum density of M-44s placed in any 100-acre pasture land areas must not exceed 10; and the density in any 1 square mile of open range shall not exceed 12.	Implementation of Use Restriction 15, on its own and in combination with Use Restriction 16, creates the potential for conflicting standards for the maximum allowable density of M-44 devices that can be set in an area. In order to simplify interpretation of Use Restrictions 15 and 16, and ensure compliance with both, Applicators must not set more than 12 M-44 devices per square mile (640 acres), whether in pasture or open range. Additionally, applicators must not set more than 10 M-44s in any pasture 100 acres in size or smaller. Applicators should exercise caution when setting M-44 devices on neighboring pastures, properties, or grazing allotments to ensure that neighboring clusters of M-44 devices do not exceed these maximum densities when considered as a single area.
16. M-44 devices must not be placed within 30 feet of a livestock carcass used as a draw station. No more than four M-44 devices may be placed per draw station and no more than five draw stations may be operated per square mile.	Use Restriction 16 allows the placement of up to 5 draw stations per square mile, and limits the number of M- 44s placed per draw station to 4. Additionally, applicators must not set more than 12 M-44s in a square mile. Implementation of Use Restriction 16, in combination with Use Restriction 15, creates the potential for conflicting standards for the maximum allowable number of M-44 that can be set in an area. In order to ensure compliance with both, Wildlife Services

UR #16 Continued.	applicators must not set more than 12 M-44 devices per square mile (640 acres), whether in pasture or open range. However, applicators must not set more than 10 M-44s in any pasture 100 acres in size or smaller. Applicators will not set M-44s within 30 feet of any livestock or other animal carcass with meat or viscera attached, regardless of whether or not the carcass is intended to be a draw station. Applicators should inspect each M-44 site to ensure that any carcass parts are at least 30 feet from the nearest M-44. Applicators should take all reasonable precautions, including staking carcasses to the ground, to prevent scavengers from dragging them to within 30 feet of any M-44s.
17. Supervisors of applicators must check the records, warning signs, and M-44 devices of each applicator at least once a year to verify that all applicable laws, regulations, and restrictions are being strictly followed.	Supervisors of applicators must conduct at least one field inspection annually to ensure records, warning signs, and M-44 devices are in compliance with all applicable laws, regulations and restrictions. These inspections will be documented on the "Field Inspection Report" (WS Form 82). Additional field inspections may be conducted as deemed necessary by the supervisor. Supervisors will also complete the "Annual M-44 Sodium Cyanide Training" form (WS Form 40) during annual field inspections to document review of applicator's knowledge of M-44 guidelines and restrictions. Additionally, supervisors will check to ensure that inventory and use records of sodium cyanide are in accordance to the CMITS requirements.
18. Each M-44 device must be visually inspected by an applicator or cooperator at least once every week, weather permitting access, to check for interference or unusual conditions; and must be serviced as required, by the applicator.	Applicators will record each required M-44 check on an MIS "Direct Control Work Task" showing the number of M-44s checked and fired (including 0 if none were fired). M-44s may be checked by cooperating ranchers. Cooperator checks will be limited to visual inspection to determine if devices have been disturbed or pulled, followed by verbal report to the applicator who will submit appropriate MIS documentation. Cooperators may not reset or handle the device and they should not disturb any animal taken with the device. Each required check prevented by adverse weather or

UR #18 Continued.	for any other reason should be documented specifically for each property or agreement in MIS.
19. Damaged or nonfunctional M-44 devices must be removed from the field.	Applicators must not discard damaged or unserviceable devices (ejector, shell holder, and/or tube) in the field, and should remove or replace damaged devices with working units as appropriate. Removal or replacement of damaged or nonfunctional M-44 devices requires no special documentation beyond routine reporting in an MIS Direct Control Work Task of the numbers of units set on the property.
20. An M-44 device must be removed from an area if, after 30 days, there is no sign that a target predator has visited the site.	"Site" in this context means the property described in the Work Initiation Document (WID) for wildlife damage management (WS Form 12A, 12B, and 12C). Documentation of predator damage to livestock anywhere on the ranch unit or allotment or other physical evidence of their presence will be regarded as evidence that a target predator has visited the site. M-44s will be removed when they are no longer needed. This decision will be made consistent with Use Restriction #7.
21. All persons authorized to possess and use sodium cyanide capsules and M-44 devices must store such capsules and devices under lock and key, including when in transit.	M-44 capsules and devices must be stored under lock and key at all times when unattended, including when in transit. Personnel will use locking metal boxes for this purpose. M-44 capsules may be transported in the cab or passenger compartment of a vehicle in a locked storage box.
22. Used sodium cyanide capsules must be disposed of by deep burial or at a proper landfill site. Incineration may be used instead of burial for disposal. Place the capsules in an incinerator or refuse hole and burn until the capsules are completely consumed. Capsules may be incinerated using either wood or diesel fuel.	Applicators under the supervision of the State Director **will not** dispose of any intact, damaged or spent M-44 sodium cyanide capsules by deep burial or incineration. Wildlife Services will dispose of any intact, damaged or spent capsules in accordance with Wildlife Services Standard Operating Procedure HS/WS 003.00. (https://usdagcc.sharepoint.com/sites/aphis-ws/safetyandhealth/SitePages/Home.aspx)

23. Bilingual warning signs in English and Spanish must be used in all areas containing M- 44 devices. All such signs must be removed when M-44 devices are removed. **a. Main entrances or commonly used access points to areas in which M-44 devices are set must be posted with warning signs to alert the public to the toxic nature of the cyanide and to the danger to pets. Install freestanding warning signs at access points or on property boundaries where no fence lines exist, as appropriate. Signs must be inspected weekly to ensure their continued presence and ensure that they are conspicuous and legible.** **b. Two elevated signs, placed in the most likely directions of approach, must be placed within 15 feet of each individual M-44 device warning persons not to handle the device.**	Warning signs are the first line of defense against accidental exposures. WS has designed "premise" signs for placement at common property access points to comply with Use Restriction 23a, and "device" signs for compliance with Use Restriction 23b. Both sign types can be acquired from the Pocatello Supply Depot. Applicators should place premise signs in a conspicuous location at all commonly used access points to the property. Additional free-standing premise signs may be placed along property boundaries where no fence lines exist if there is reason to believe people may access the property in that location. Applicators must install two WS authorized elevated signs ("device sign") as required by Use Restriction #23(b). Device signs must be securely anchored to a stake, post or wire and they must be positioned vertically above ground level. Device signs may also be hung from a low hanging tree limb in a manner that renders the sign clearly visible. Device signs must be placed within 15 feet of each device and in the most likely direction of approach by persons traversing the area. All signs must be inspected weekly to ensure they remain present, properly placed, and legible. All warning signs must be removed when M-44 devices are removed from the field. In addition to placing warning signs, applicators must advise resource/land owners of the dangers of sodium cyanide, and the potential for death or injury to people, pets, and livestock if M-44s are misused. Ranchers and landowners are responsible to inform any persons entering their property of the presence and hazards of M-44 devices.
24. In all areas where the use of the M-44 device is anticipated, local medical people must be notified of the intended use. This notification may be through a	Where local hospitals and medical centers rely on poison control centers for help in treating poisoning cases, notification of the poison control centers will meet this requirement. If hospitals in an applicator's area do not use or do not have access to a poison control

poison control center, local medical society, the Public Health Service, or directly to a doctor or hospital. It must be the responsibility of the supervisor to perform this function. Notifications must be made at least annually.	center, hospitals and medical clinics will be notified individually. Such written notifications will be made by State Office personnel, District Supervisors, or the designated field personnel in the local area where M- 44s are to be used. Copies of written materials documenting the required notifications will be kept at the State Office. Notifications must be made at least annually.
25. Each authorized M-44 applicator must keep records dealing with the placement of the device and the results of each placement. Such records must include, but need not be limited to: **a. The number of devices placed.** **b. The location of each device placed.** **c. The date of each placement, as well as the date of each inspection and removal.** **d. The number and location of devices which have been discharged and the apparent reason for each discharge.** **e. Species of animals taken.** **f. All accidents or injuries to humans or domestic animals.**	In general, applicator's records must be detailed enough to account for the locations of all M-44 equipment and capsules, as well as for all results of M-44 use. Items under Use Restriction #25(a), (c), and (e) must be recorded in MIS "Direct Control Work Task section." To comply with Use Restriction #25(b), Wildlife Services applicators must document the GPS coordinates of each device placed. Each date of inspection (Use Restriction #25(c)) and status of M-44s set (discharged) on each property will be recorded on a separate work task. Each required check that cannot be made due to adverse weather or for any other reason must be documented specifically for each property or agreement. If a state pesticide regulatory agency requires M-44 location information to be recorded in a different format, then the applicator must also adhere to that requirement unless an exception has been granted by the regulatory agency. The apparent reason for discharge (Use Restriction #25(d)) is normally recorded only when the applicator can identify the apparent reason based on physical evidence. Applicators will not speculate about apparent reason(s) for discharge when evidence is lacking. If the reason for the discharge is unknown, the report must identify the reason as "unknown". If the State Director or supervisor determines the reasons for discharge need to be documented in greater detail than is possible in MIS, the supervisor will direct the employee as to what report format to use. In addition to the records mandated by Use Restriction #25, WS applicators are required to provide pesticide application records to each cooperator or landowner

UR #25 Continued.	within 30 days of applying pesticides. WS M-44 applicators can comply with this regulation by notifying the landowner/cooperator in writing that WS will maintain these records, if the landowner agrees, and will provide copies upon request. The "Work Initiation Document for Wildlife Damage Management" form (WS Form 12A, 12B and 12C) includes the above notification.
26. The M-44 device must not be used within 600 feet of occupied residences, except those of any cooperating entity who has given APHIS written permission for M-44 device placement on their property.	M-44s will not be placed within 600 feet 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 authorizing their use. Even if a cooperator authorizes M-44 use, the device must comply with all other use restrictions including 8(2) prohibiting placement in areas where exposure to the public and family or pets is probable. Personnel are responsible for accurately identifying property boundaries where M-44 devices are to be placed. If the property boundaries are not clearly posted, or if the landowner, manager or lessor is unable to accurately identify the property boundaries, WS personnel shall use electronic mapping or aerial imagery to: a) ensure devices are placed within the boundaries of property covered by the agreement; and b) identify non-cooperator residences within 0.5 mile of the device and/or residences that may require notification, per Use Restriction #27. Buildings that are obviously abandoned or not actively occupied are not considered residences. Applicators should err on the side of caution when evaluating the seasonal or periodic occupancy of hunting camps and other temporary residences.
27. Prior to device placement, APHIS must notify any occupied residence within 0.5 miles of an M-44 device of the presence of M-44s by one or more of the following methods: face-to-face communication, person to	Before placing an M-44, applicators will notify the occupants of any residence within 0.5 miles of the anticipated device location of the use of the device in the area. Buildings that are obviously abandoned or not actively occupied are not considered residences. Applicators should err on the side of caution when evaluating the seasonal or periodic occupancy of

person telephone conversation (voice message is not acceptable), door hanger notice, certified mail.	hunting camps and other temporary residences for notification purposes. Applicators will use one or more of the following notification methods: face-to-face communication, person to person telephone conversation, door hangers, or certified mail. Voice messages are not sufficient to satisfy this requirement. The identity of the Cooperator and of the Cooperator's property will not be shared directly with the notified individuals unless the Cooperator has authorized disclosure in writing. Applicators will document notification on WS Form 205A. Completed forms will be maintained by the WS State Director or their WS designee.

2.4.1.7 Translocation of Wildlife

WS Directive 2.501: Translocation of Wildlife

a.	*Translocation of wildlife from one geographic area to another may be conducted by WS personnel as a wildlife damage management activity when: a. Such activities are in accordance with the policies of regulating state and/or Federal wildlife management agencies. b. Such activities are in accordance with all applicable Federal, State, and local laws and regulations.*
b.	*Primary factors influencing translocation include availability of suitable habitat, impact (competition, predation, etc.), on the animals(s) to be moved as well as other species, the likelihood of animal returning, public attitudes, and potential for creating a damage/conflict situation at the new location.*

2.4.1.8 Disposal of Carcasses

WS Directive 2.515: Disposal of Wildlife Carcasses and Furs
WS Directive 2.510: Animal Parts and Edible Meat

a.	All wildlife carcasses, whether in whole or part, will be disposed of consistent with Federal, State, county, and local regulations and WS Directive 2.210 "Compliance with Federal, State, and Local Laws and Regulations". Animals euthanized with drugs 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. (WS Directive 2.515)
b.	Wildlife carcasses may be discarded on the property where they were killed or recovered, or deposited on another cooperator's property if approved by the respective

	property owner. Carcasses may be composted following Federal, state, and local laws. Wildlife carcasses or parts may be disposed of at approved public or private landfills where such facilities are approved for animal disposal. Carcasses shall not be deposited in roadside or commercial business dumpsters unless prior approval to do so has been obtained from the dumpster owner or lessee. Carcasses shall not be disposed of in household trash containers. Wildlife carcasses may be incinerated in approved facilities that comply with Federal, State, and local regulations. Open burning should be avoided due to potential fire hazards except when this method is required by regulations and can be conducted safely. All disposals will be made in a manner which demonstrates WS' recognition of public sensitivity to the viewing of wildlife carcasses. (WS Directive 2.515)
c.	*Furs, animal parts, or edible meat may be donated, salvaged, sold, or transferred when authorized by the State Director, in compliance with existing cooperative agreements, Memoranda of Understanding, and all applicable Federal, State, and local laws and regulations. Refer to WS Directive 2.510 "Fur, Other Animal Parts, and Edible Meat" for guidelines.* (WS Directive 2.515)
d.	*Feathers, claws, or other animal parts (except eagle parts and parts from the Federal and State listed threatened or endangered species) may be donated or transferred to Native Americans for ceremonial or religious purposes, or to universities, museums, State wildlife agencies, or other reputable organizations for use in scientific or educational purposes. Donating, transferring or transporting protected species will be coordinated through the State Director and cleared with the State wildlife agency, and in cases involving Federally protected species, with the USFWS. WS employees or family members, close relatives or acquaintances may not benefit from any animal(s), in whole or in part, taken by WS employees while conducting official duties. This includes but is not limited to, edible meats, fur, or valuable animal parts. Animal parts commonly used for making scents, baits, lures, and attractants, are excluded.* (WS Directive 2.510)

2.4.1.9 Immobilization and Euthanasia

WS Directive 2.505: Lethal Control of Animals [Euthanasia]
WS Directive 2.430: Chemical Immobilization and Euthanizing Agents [I&E]

a.	*WS personnel will exhibit a high level of respect and professionalism when taking an animal's life, regardless of method. WS personnel will be familiar with the methods described in the current AVMA Guidelines for Euthanasia, and those methods will be used to euthanize captured or restrained animals, whenever practicable. In free-ranging wildlife, the AVMA recommends methods "be as age-, species-, or taxonomic/class-specific as possible." WS personnel will use methods appropriate for the species and conditions.* (WS Directive 2.505)
b.	*When euthanizing a captured or restrained animal, death of the animal must be confirmed; death should be confirmed in free-ranging wildlife when carcass recovery is possible. Confirmation can be achieved by the absence of a blinking response when the cornea is touched and by monitoring heart rate and respiration for a period of time long enough to confirm death.* (WS Directive 2.505)
c.	All WS-New Mexico personnel requiring use of immobilization and euthanizing drugs must comply with WS Directive 2.430 "Controlled Chemical Immobilization and Euthanizing Agents", including full training and certification. *WS personnel using I&E drugs must receive training approved by the WS I&E Committee prior to independent*

	use of possession of I&E drugs (Attachment 1). (WS Directive 2.430)
d.	*Only I&E drugs approved by the WS I&E Committee can be used by WS personnel, unless under emergency situations (Attachment 2).* [Note: Attachment 2 of WS Directive 2.430 lists the approved I&E drugs.] *In emergency situations, unapproved I&E drugs can be used on a one-time or limited basis by WS personnel when approved by an attending/consulting veterinarian and the State director or designee, provided that such use is in compliance with all applicable laws.* (WS Directive 2.430)

2.4.1.10 Wildlife Hazards to Aviation

WS Directive 2.305: Wildlife Hazards to Aviation

a.	*WS-New Mexico personnel working at airports with WS agreements will notify the appropriate civil or military airport authorities as soon as practicable when imminent wildlife hazards to aviation are observed.*
b.	*WS-New Mexico managers will ensure that WS employees working at aviation facilities are provided with appropriate training and certifications commensurate with the responsibilities of their positions.*

2.4.1.11 Training for Aerial Operations

WS Directive 2.620: Required Training for Aerial Operations

a.	*All WS' aerial operations and safety activities, including training and maintenance, will be conducted in strict compliance with the WS Aviation Operations and Safety Manual;,the Federal Aviation Regulations (FAR), the Fish and Wildlife Act of 1956 (Airborne Hunting), any applicable State and local laws and regulations, individual WS State and WS National Wildlife Research Center program Aviation Safety Plans, Aviation Communication Plan, and Aviation Emergency Response Plans. All pilots, crewmembers, ground crews, and aircraft maintenance personnel will adhere to the WS Aviation Operations and Safety Manual and its amendments, Title 14 Code of Federal Regulations (CFR) and FAR Part 43, 61, 91, 119, 133, 135, and 137. No aircraft shall be used in WS activities (either through contract, agreement, or volunteer) that have not been approved through the office of the WS national Aviation Coordinator (NAC), except for military transport and commercial travel purposes.*

2.4.1.12 Personnel Safety

WS Directive 2.601 : Safety [of WS personnel]
WS Directive 2.635: Zoonotic Diseases and Personal Protective Equipment

a.	*WS supervisors will promote a safe working attitude among employees. Supervisors will identify hazards, including wildlife-borne diseases, in advance of work assignments. Supervisors will also provide employees with adequate information, training, and personnel protective equipment to optimize employee safety.* (WS Directive 2.601)
b.	*WS employees will adhere to safety requirements and use appropriate personal protective equipment provided for assigned work. Employees are required to immediately report unsafe working conditions to their supervisor and work cooperatively to minimize hazardous working conditions*. (WS Directive 2.601)
c.	*WS personnel are advised to alert their physician that they may be exposed to wildlife-*

	borne diseases. Serious diseases including rabies, hantavirus, plague, Lyme disease, psittacosis, Clamydia psittaci, or histoplasmosis may be misdiagnosed unless the physician is aware of the possibility of exposure. (WS Directive 2.601)
d.	*WS employees will be provided with a Physicians Alert Card (APHIS Form 260 or APHIS Form 260A) which identifies a number of the more significant zoonotic diseases personnel are likely to encounter. Personnel will use the Physician's Alert Card when conferring with their physician about any illnesses or suspicious symptoms. Physical injury events such as animal scratches or bites (including embedded ticks) should be reported to the supervisor as soon as possible and documented within 30 days on a US Department of Labor Form CA-1…If an employee experiences signs or symptoms of a suspected work-related illness, zoonotic disease, or parasitic infection/infestation, the employee should notify their supervisor as soon as possible and seek medical attention for a diagnosis and confirmation from a physician that the condition is in fact work-related.* (WS Directive 2.635)
e.	*All WS personnel who handle or are exposed to wildlife, biological samples, or equipment used to handle or process animals or biological materials will be provided disease safety, biosecurity, and PPE training as prescribed in the WS Biological Risk Management Training Manual. Specific PPE requirements will vary among positions and the specific duties of personnel. All PPE supplies (e.g. gloves, safety glasses, DEET) will be routinely monitored and supplemented or replaced as necessary.* (WS Directive 2.635)

2.4.1.13 Livestock Guarding Dogs

WS Directive 2.440: Livestock Guarding Dogs

a.	*All WS field personnel will be knowledgeable in the use and application of livestock guarding dogs. WS field personnel will assist producers who may be interested in using livestock guarding dogs by providing information and/or referring them to a WS guarding dog specialist for further assistance. Livestock guarding dogs are generally owned and managed by the livestock producer and are recognized by WS as useful for reducing predation.*
b.	*WS specialists must be cautious when working near or around guarding dogs to minimize potential hazards from applied management methods.*

2.4.1.14 Use of Trained Dogs

WS Directive 2.445: Use of Trained Dogs in WS Activities

a.	*It is WS policy that trained dogs shall only be used by authorized personnel, including volunteers and contractors, to conduct specific WS functions. It is permissible for WS personnel to use employee-owned or government-owned trained dogs in accomplishing WS missions where it is safe and legal to do so. Government-owned and employee-owned trained dogs should accompany the WS employee/handler on official duty only when there is an operational need.*
b.	*Use of contract or volunteered dogs (e.g. dogs not directly owned by WS or its employees) will be approved on a case-by-case basis by the applicable State Director. In such instances, the contracted or volunteer dog-handler must sign a form acknowledging that they will abide by WS Directive 2.445. In such instances the dog-handler must follow WS' guidelines and a WS employee must accompany the*

	contract/volunteer dog handler throughout the operation.
c.	*Dogs will not be allowed to intentionally kill animals. When the objective is removal, animals will be euthanized as quickly as possible via mortal gunshot. Mortal gunshot is the only approved means of euthanasia.*
d.	Functions performed by trained dogs: wildlife hazing away from property or other resources; target animal detection to determine if further action is warranted; animal retrieval; decoying target wildlife into shooting range; trailing target animals to facilitate live capture or lethal removal.
e.	*WS personnel shall not allow trained dogs to have physical contact with or in any way attack, bite, or kill animals that are restrained in a trap or any other device. When trained dogs are used, handlers will be at the site of encounters between animals and dogs as soon as possible to minimize stress and reduce potential injury. If WS personnel are unable to prevent a trained dog from repeatedly making contact with a restrained animal, WS personnel must immediately intervene and discontinue use of that dog.*
f.	*WS personnel shall ensure a dog-in-training is muzzled and controlled on a leash when it is near a restrained animal. If the dog-in-training attacks or attempts to attack a restrained animals, WS personnel must immediately stop the interaction. WS personnel must discontinue use of dogs-in-training that repeatedly attempt to physically contact restrained animals.*
g.	*WS personnel shall ensure trained dogs used in wildlife damage management activities receive housing, food, water, medical care, and are properly licensed and vaccinated according to state and local laws. WS personnel shall ensure dogs are provided a safe transport box. The box shall provide enough shade and ventilation during warm months to keep dogs cool. During cool months, insulation and/or reduced ventilation shall be used to keep dogs comfortable.*
h.	*Dog handlers shall control or monitor their trained dogs at all times. A trained dog is considered under control when the dog responds to the command(s) of the dog handler by exhibiting the desired or intended behavior as directed. Dog handlers shall ensure trained dogs to not pose a threat to humans or domestic animals, or cause damage to property. Further, dog handlers (whether WS employees or contractors) shall employ as needed various methods and equipment to monitor and/or control dogs, including but not limited to: muzzles, protective vests and collars, electronic training collars, harnesses, leashes, whistles, voice commands, global positioning system (GPS), telemetry collars, identification collar/contract information.*

2.4.1.15 Feral, Free-Ranging, and Hybrid Dog Management

Directive 2.340: Feral, Free-Ranging and Hybrid Dog Damage Management WS

a.	*Where WS personnel determine that a captured dog is a pet, WS-New Mexico personnel shall inform the land/resource owner as soon as is practicable.*
b.	*In urban areas where local animal control officers exist [Note: or the New Mexico State Patrol are available], WS personnel shall collaborate with them to determine if WS action is necessary to solve the property or human health and safety problem associated with feral, free-ranging, or hybrid dogs. If WS action is necessary and requested by the local authority, WS personnel must achieve/conduct the following: (1) Written approval of the WS Regional Director; (2) Notification to the WS Deputy Administrator; and (3)*

	Written request from the State, local or tribal authority with jurisdiction over feral, free-ranging, or hybrid dogs, if such local authorities with jurisdiction exist. WS personnel shall ensure that written requests for assistance include: (1) a statement of the problem; (2) the location and time frame for WS activities; and (3) sufficient details regarding the scope of the assistance requested.

1.4.1.16 Tribal Government-to-Government Consultations

WS Directive 1040.3: Tribal Government-to-Government Consultations

a.	T*his Directive implements Executive Order (EO) 13175 ["Consultation and Coordination with Indian Tribal Governments."] regarding consultation, collaboration, and coordination with Tribes. APHIS will respect the rights of sovereign tribal governments and provide an opportunity for Tribes to participate in policy and program development. Each Tribe will be provided an opportunity for timely and meaningful government-to-government consultation regarding policy actions that may have tribal implications. This Directive does not preclude APHIS from consulting with a Tribe when the Tribe and the agency agree that consultation may be desirable, even if consultation is not specifically required. To enhance the evolution of working relationships and mutual partnerships between APHIS and Native American governments, the Agency will be flexible. APHIS should accept all requests for consultation; the emphasis must be on accepting opportunities rather than declining. Consultation does not require APHIS to do everything a tribal representative requests, but rather requires the agency to take the Tribes' views, information, rights, and interests into serious deliberative consideration. Consultation should be part of an effort to cooperate and collaborate in good faith with tribal partners.*

1.4.1.17 Federally Threatened and Endangered Species

WS Directive 2.310: Endangered and Threatened Species

Please see previous sections of Part A for relevant APHIS-WS Directives related to capture, use of chemicals, carcass disposal, and firearm use and safety that could also minimize the risk of adversely affecting Federally-listed threatened and endangered species.

a.	*WS will conduct its activities to minimize impact on any federally listed endangered or threatened species or adversely modifying listed critical habitat.*
b.	*WS State Directors will assure that all of their WS employees (Federal and non-Federal) are familiar with the requirements of Section 7 of the Endangered Species Act, as amended. WS employees will also be familiar with Section 7 biological opinions on listed species potentially impacted by their wildlife damage management activities.*
c.	*WS State Directors will initiate consultation with the US Fish and Wildlife Service (FWS) if new damage management programs, new methods, or newly listed species result in the potential for adverse impacts.*
d.	*During routine work activities, incidents involving impacts on listed species will be reported by WS field personnel within 24 hours to the appropriate WS supervisor.*
e.	*Unless otherwise authorized, the location of dead or seriously injured listed species will be immediately reported to the appropriate FWS Law Enforcement Office and State wildlife representative.*

f.	*When endangered species are responsible for causing damage, the WS State Director will work with the FWS to determine if acceptable solutions for controlling damage can be agreed upon and implemented.*
g.	*When a managing agency (Federal, state, tribal) requests WS assistance in protecting listed species or controlling damages caused by listed species, the requesting agency will bear responsibility for funding the work. The WS State Director will coordinate with appropriate Federal, state, and local agencies to arrange funding and determine acceptable control procedures.*

2.4.2 Formal and informal consultations with the USFWS for New Mexico.

WS-New Mexico has completed informal and formal consultation with the USFWS per Section 7 of the Endangered Species Act for effects of all WS-New Mexico activities on federally-listed threatened and endangered species. The effects analyses and findings pertinent to this EA on federally-listed species based on consultations completed December 16, 2014, are included in Sections 3.6. WS-New Mexico continues to consult with the USFWS as needed to maintain compliance with the ESA for WS-New Mexico activities. WS Protective Measures improve the safety, selectivity, and efficacy of activities intended to resolve wildlife damage. New Mexico WS uses many such measures. The protective measures would be incorporated into activities conducted by WS under the appropriate alternatives when addressing predator damage and threats in New Mexico. The following list of measures from the informal and formal ESA consultation documentation addresses only those methods appropriate for terrestrial PDM activities for target species within the scope of this EA.

1.4.2.1 Protective Measures from the 2014 Biological Assessment (BA) and USFWS Concurrence Letter for WS-New Mexico Effects on All Federally-listed Species

a.	WS personnel are highly experienced and trained to select the most appropriate method(s) for taking problem animals with little impact to T&E species. When working in an area that has T&E species or the potential for T&E species to be exposed to WDM methods, WS personnel will know how to identify sign of the target and T&E species and use WDM methods accordingly.
b.	WS personnel work with research programs such as the WS-National Wildlife Research Center to continue to improve the selectivity of management devices.
c.	WS personnel using 4-wheel ATVs will use roads and existing trails as possible to conduct field work.
d.	If WS resumes disease surveillance involving bird species such as waterfowl and shorebirds, a new consultation will be conducted specifically for that program with USFWS. T&E species that could be taken in AI surveillance include piping plover and least tern. Other disease surveillance work (e.g., rabies, plague, and West Nile virus) could involve other species, depending on the type and location of the action.
e.	WS will notify USFWS about intensive FSDM when it is going to be conducted in the range of a species that could be impacted by feral swine.
	Within Black-footed Ferret habitat (May Affect, Not Likely to Adversely Affect; MANLAA): WS will consult with USFWS prior to conducting WDM on Moore Ranch near Wagon Mound, New Mexico, where a permitted experimental population exists. USFWS has determined that naturally occurring populations of black-footed ferrets no longer exist in New Mexico, and thus, WS will have no effect on them in areas outside of Moore Ranch.

	Within occupied Canada lynx habitat (if and when lynx habitat becomes occupied in New Mexico, MANLAA): WS will provide training for their personnel in the identification of lynx and lynx sign, and snowshoe hare and their sign if conducting predator damage management activities within lynx habitat. Lynx "occupied" habitat will be considered any place where lynx or their sign have been found and consists of coniferous forests above 8,000 ft. (above sea level). Fetid baits and attractants at coyote trap sets will not be used in lynx "occupied" habitat. Leg-hold traps and foot or leg snares set for larger predators (e.g., mountain lions, black bears, and wolves) will be 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 yards of lynx "occupied" habitat. Neck snares for coyotes or bobcats will not be placed within 100 yards of any conifer forest type above 8,000 feet elevation (above sea level) in lynx "occupied" habitat. M-44 devices or LPCs will not be used within 100 yards of any conifer forest type above 8,000 feet elevation (above sea level). Tracking dogs will be removed as soon as possible from trailing a lynx. Any lynx incidentally captured in any equipment uninjured will be immediately released. If a lynx has been non-fatally injured, WS shall transport the animal to the nearest veterinarian and shall contact USFWS or NMDGF 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. WS shall use humane measures to euthanize the injured animal. Any lynx trapped, treed, lethally taken, or lynx-related observations are to be reported to the nearest USFWS, including the date, specific location, method of taking or observation, and the nature and extent of any injuries sustained. WS will notify USFWS 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.
	Within Jaguar habitat: WS will abide by the RPAs & RPMs as given in the 1999 BO (USFWS 1999a, b).
	Within T&E and Sensitive Plant Species habitat: WS will not conduct beaver dam removal where T&E species occur without consulting further with USFWS. WS will avoid ingress and egress routes in occupied areas. WS personnel will not collect plants while afield. WS personnel will wash vehicles regularly to ensure WS does not spread invasive plant seeds. WS personnel that travel with horses to areas where T&E species may be present will feed them certified weed-free hay.
	Within Mexican Gray Wolf habitat: WS personnel will abide by all RPMs and T/Cs outlined in the BO and Conference Opinion for this species to avoid take. Within the Blue Range Wolf Recovery Area (BRWRA), New Mexico WS Specialists will not shoot at canids beyond a distance of 100 yards, unless authorized by USFWS for Mexican wolf removal. Outside the BRWRA, New Mexico WS Specialists will not shoot at canids beyond a distance of 100 yards when wolves are known to be in the area, unless authorized by USFWS for a wolf removal. WS will not conduct night shooting activities including spotlighting, using starlight scopes, infrared, or other night vision devices within the BRWRA or other areas for canids when wolves

	are known to be present, unless authorized by USFWS for wolf removal, or when necessary to manage public health or safety threats including, but not limited to, rabies.
	Within Lesser Prairie-Chicken habitat: During breeding season (late March through late May), WS will avoid historical leks with aircraft by a quarter mile or more or where a new one is discovered. If a coyote or feral hog is seen in the lek, it can be pursued because it will have already disrupted the lek. Use of leghold traps for smaller predators is exceedingly rare in New Mexico and will only be used in prairie-chicken areas where the prairie-chicken will not have access to it. Larger cage traps used for predators, *e.g*., bobcats and raccoons, could capture a prairie-chicken when used in their habitat. Thus, WS will monitor the larger cage traps daily when used in grouse habitat and release any grouse caught. Rodenticides used for rodents such as prairie dogs and ground squirrels will be used according to label procedures to avoid the accidental take of prairie-chickens.

2.4.3 Additional measures

2.4.3.1 Protection of Human/Pet Health and Safety

a.	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.
b.	Although unlikely, in the event that WS-New Mexico is requested to immobilize bears by NMDGF and in which NMDGF is involved either during a period of time when licensed harvest of bears is occurring or during a period of time where the drug withdrawal period could overlap with the start of a harvest season, WS would euthanize the bear or mark the animal with ear tags labeled with a "*do not eat*" warning prior to release.
c.	In most cases, 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. Sometimes culvert traps are used in and near campgrounds, developments, dumpsters, and other areas which attract bears. Trap warning signs are placed on each end of the trap.
d.	Public safety zones are delineated and defined by location during annual Work Plan meetings with BLM and USFS, and changed or updated as necessary. The public safety zone is one-half mile, or other appropriate distance, around any occupied dwelling or community, county, or developed recreation site. PDM conducted on federal lands within identified public safety zones will generally be limited to activity aimed at the protection of human health and safety. However, a land management agency or cooperator could request PDM activities in the public safety zone for an identified need. Depending of the situation and applicable laws and regulations, WS-New Mexico could provide them service. However, the land management agencies would be notified of PDM activities that involve methods of concern such as M-44's, firearms, dogs, and traps before these methods would be used in a public safety zone, unless specified otherwise in the AWP and as appropriate.

2.4.3.2 Operating on Public Lands, Including in Wilderness Areas, Wilderness Study Areas (WSAs), and other Special Management Areas on Federal Lands

a.	All WS-New Mexico PDM actions conducted on BLM or US Forest Service lands are conducted per the interagency MOUs with associated annual work plans (see Section 1.9.2).
b.	PDM conducted within BLM and Forest Service WSAs and Wilderness Areas is closely coordinated with the land management agency and performed in accordance with the BLM and APHIS-WS MOU, the Forest Service and APHIS-WS MOU, and the Wilderness Act (16 U.S.C. 1131-1136).
c.	Outside of wilderness and wilderness study areas, any unanticipated work not included in the Annual Work Plan will be coordinated with the BLM Field Office Manager or USFS District Ranger or his/her representative.

2.4.3.3 Miscellaneous Measures

a.	WS-New Mexico will use caution when operating in eagle occupied territories, and will consult with USFWS to determine appropriate measures for avoiding unintentional take.
b.	**Use of Non-lead Ammunition.** WS-New Mexico will use non-lead ammunition when required by land management policies and as required by Federal, state, and tribal laws and when and where required by ESA Section 7 consultations.
c.	**Use of Existing Access.** Vehicle use is limited to existing roads and trails unless authorized by the land management agency or landowner for specific actions.
d	**Code of Ethics:** The APHIS-WS Code of Ethics requires that all WS employees maintain high personal and professional standards in support of the WS mission to provide Federal leadership in wildlife damage management solutions that are safe, effective, selective, economically feasible, and environmentally responsible. (WS Directive 1.301**).**

2.4.3.4 WS-New Mexico PDM Policies for Compliance with Senate Bill 32 (Section 2.4.4.7)

a.	WS-New Mexico will not use any toxicants for PDM on public land as described in Senate Bill 32. This includes M-44s (sodium cyanide), LPCs (sodium fluoroacetate), and gas cartridges (sodium nitrate).
b.	WS-New Mexico will not use any lethal trap on public land, including lethal body gripping traps or neck snares as described in Senate Bill 32.
c.	WS-New Mexico will place visible signs at the location of each trap notifying the public of the presence of such devices for all traps set on public land as described in Senate Bill 32
d.	All WS-New Mexico PDM activities on public lands must be authorized by the applicable state wildlife management agency.

2.4.4 Relevant state laws and regulations

Measures included in this section from relevant state laws and regulations are paraphrased. This is not intended to be a complete and comprehensive list; please see the legal wording of state laws and regulations for more information.

2.4.4.1 Categories of Wildlife and Legal Take

NMSA 17.5.2: Defines furbearers, which includes muskrat, mink, weasel, beaver, otter, nutria, masked or black-footed ferret, ringtail cat, raccoon, pine marten, coatimundi, badgers, bobcat and all species of foxes.

NMSA 17.2.41. Endangered species
This state law that provides special protection to state designated T/E species.

NMAC 19.31.11.13 PROCEDURES FOR CONDUCTING COUGAR DEPREDATION CONTROL IN OCCUPIED BIGHORN SHEEP RANGES:

A. The department shall investigate all bighorn sheep deaths to determine if cougar depredation has occurred. To determine cougar depredation, a field examination and a standardized necropsy of the dead bighorn sheep shall be completed by a department employee or contractor.

B. Should it be determined that a depredation has occurred, the following procedures will be used.

(1) The department will make an evaluation of the following: viability of the statewide bighorn population, review of long-term and recent data on the local population (or meta-population), review of data on recent predation, alternative management options such as habitat manipulation or transplants, feasibility of taking the offending animal(s), effects on the predator population, and feasibility of having a positive effect on the local bighorn population.

(2) The wildlife management division and the appropriate area operations office will be contacted.

(3) A permit for the taking of each depredating cougar(s) will be issued to the local district wildlife officer. Physical possession of the permit is not required to initiate action.

(4) A decision to hound hunt or snare will be based on evidence at the kill site.

(5) If the bighorn sheep kill is fresh enough that the cougar may return or is likely to still be in the immediate area, the department will attempt to get a hound-hunter or trapper to begin hunting the cougar(s) the same day the bighorn carcass is discovered.

(6) The size of the hunted area will be determined from the sex and, in some cases, number of cougars (i.e. female with kittens) involved in the bighorn kill.

(7) Where possible, cougar feces shall be taken at the scene of the depredation and tissue samples from the cougar killed by the hunter(s) will be collected. Deoxyribonucleic acid (DNA) testing will be performed to determine if the scat and tissue samples are from the same cougar.

NMAC 19.31.11.15 PROCEDURES FOR CONDUCTING PREVENTIVE COUGAR CONTROL IN BIGHORN SHEEP RANGES:

A. The New Mexico department of game and fish may conduct preventive cougar control within bighorn sheep ranges.

B. The total number of cougars removed per license year from any zone containing bighorn ranges will not exceed the sustainable mortality limit for that zone unless approved pursuant to 19.31.11.8 NMAC.

C. The department will obtain the services of houndsmen or trappers either from the department's depredation list or through private contract.

D. A decision to hunt with hounds or to use snares will be made by the department.

E. All cougars taken for preventive control will be reported to the department.

F. The department will provide a program evaluation update to the commission no later than December biennially beginning in December 2010.

2.4.4.2 Use of Artificial Light

NMAC 19.30.13.11 DEPARTMENT AUTHORIZATION - RACCOON HUNTING: A validly licensed furbearer hunter is authorized by the department to hunt for and take raccoons by use of artificial light while hunting at night with a rim-fire rifle or handgun no greater in size than a .22 caliber, shotgun, bow or crossbow during open season. The artificial light used for raccoon hunting must be a headlamp or hand-held flashlight. It is unlawful for any artificial light to be cast from a vehicle while raccoon hunting.

2.4.4.3 Use of Traps, Snares and Other Capture Devices

NMAC 19.32.2.10 MANNER AND METHOD OF TAKING FURBEARERS:

A. Legal methods of taking shall include dogs, firearms, crossbows, falconry, bows and arrows, or traps and snares.

B. The following restrictions on traps and snares shall apply to the setting of any trap or snare that could reasonably be expected to catch a furbearer.

(1) Each trap or snare set that could take furbearers must be either permanently marked with a user-identification number that is issued by the department of game and fish, or be permanently marked with the name and address of the trapper using the trap or snare.

(2) No foot-hold trap with an outside spread larger than 7 inches if laminated above the jaw surfaces or tooth-jawed traps, shall be used in making a land set. All foot-hold traps with an inside jaw spread equal to or greater than 5.5 inches shall be offset unless they have padded jaws.

(3) No land set shall be placed within 1/4 mile of a designated and signed roadside rest area, picnic area or an occupied dwelling without prior, written permission of the occupant of the dwelling, except for a land set placed by a landowner on his own land.

(4) No land set shall be placed within 1/2 mile of an established and maintained public campground, or boat-launching area.

(5) It shall be unlawful to make a land set within 25 yards of the edge of any public road or trail (including any culvert or structure located beneath it) except on private land with written permission from the landowner. Trail shall mean any path opened for public use and maintained annually by public funds or any path published on a map by a municipal, state or federal agency and open for public travel. Public road shall mean any thoroughfare that was constructed and annually maintained with public funds whether it is currently open or closed to vehicle use or any thoroughfare published on a map by a municipal, state or federal agency and open for public travel.

When a fence is present within 25 yards of the edge of the road, sets may be made on the side of the fence opposite the road.

(6) No land set shall be placed within 50 yards of any man-made livestock or wildlife catchment, pond or tank containing water, except on private land with written permission from the landowner.

(7) No steel trap with an inside jaw spread larger than 7.5 inches or body-gripping trap with a jaw spread greater than 12 inches shall be used in making a water set.

(8) It shall be illegal to place, set or maintain any steel trap or snare within 25 feet of bait that is visible from any angle and that consist of the flesh, hide, fur, viscera, or feathers of any animal unless used in conjunction with a cubby set where the bait cannot be seen except from a height of 3 feet or less above ground level and at a maximum distance of 25 feet. The bait must be inside the cubby but the steel trap or snare may be outside. Bones that are entirely free of flesh, hide, fur or feathers may be used as visible bait. The restriction on visible bait shall not apply to a trap flag that is suspended above the ground and that is made from materials other than animal parts.

(9) No body-gripping trap with an inside jaw spread greater than 7 inches may be set on land. Body-gripping traps with inside jaw spreads of between 6 and 7 inches set on land shall be used in conjunction with a cubby set such that the trap trigger is recessed in the cubby at least 8 inches from an entrance.

(10) Shooting hours:

(a) Hunting and falconry - ½ hour before sunrise to ½ hour after Sunset.

(b) Trapping - unrestricted.

NMAC 19.32.2.11 TRAP INSPECTION AND FURBEARER REMOVAL:

A. A licensed trapper, or his/her agent, must make a visual inspection of each trap each calendar day and remove any captured wildlife. A release device or catchpole shall be carried to release captured animals. All traps must be personally checked by the trapper every other calendar day. Each trapper will be allowed multiple agents who must possess written permission from the trapper and a valid trapper license. The permission must include the trapper's full name, address, trapper's license number, trapper identification number(s), if appropriate, and general location or route of traps.

B. It shall be illegal to import any live furbearer into the state. It shall be illegal to hold any live furbearer in captivity except raccoons held under a valid New Mexico department of game and fish live animal permit. Upon written application, the director may issue a permit for retention of raccoon, or other activity permitted under 19.31.10 NMAC.

C. It shall be illegal to destroy, disturb or remove any trap, snare or trapped wildlife belonging to a licensed trapper without permission of the owner of the trap or snare, except that from March 16 to November 1, a landowner may remove any trap or snare from privately owned or leased land if such a trap or snare could endanger livestock. Nothing in this subsection shall prohibit a person from releasing any domestic animal from a trap.

NMAC 19.32.2.12 TRAP INSPECTION AND FURBEARER REMOVAL EXEMPTIONS: The provisions of this regulation shall not apply to personnel of the department of game and fish or its designated agents who are acting in their official capacity in the control of depredating animals or for management purposes.

NMAC 19.31.11.10 BEAR AND COUGAR MANNER AND METHOD REQUIREMENTS AND RESTRICTIONS: Hunters with a valid cougar license may use traps or foot snares to harvest cougars on state trust land, or private deeded land with written permission from the landowner. Neck snares are not permitted. Restrictions for cougar take using traps or foot snares shall follow the regulations on methods, trap specification, trap inspection, and cougar removal as defined in 19.32.2.10 NMAC Manner and Method of Take, and 19.32.2.11 NMAC Trap Inspection and Furbearer Removal. Foot snares shall be prohibited in GMU 27 and those portions of GMU 26 designated by the United States fish and wildlife service as critical habitat for jaguar.

2.4.4.4 Depredation Permits and Procedure's

NMAC 17-5-3. Seasons; special permits to take animals doing damage.
Fur-bearing animals as defined in Section 17-5-2 NMSA 1978 shall be taken only during the seasons declared by regulation of the state game commission promulgated as provided in Section 17-5-4 NMSA 1978. The director may, however, issue permits at any time for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock.

NMAC 17-3-31. Permit to capture or destroy protected game damaging crops or property; beavers.
The state game and fish warden [director of the department of game and fish] may grant permits to owners or lessees of land and for the capture or destruction on their lands of any protected game doing damage to their cultivated crops or property; provided, that on said permit or permits so issued as aforesaid, the state game and fish warden shall fix the numerical limit of any protected game so to be captured or destroyed and shall also therein fix the time limit within which any such protected game shall be so captured.

NMAC 19.30.6. Predator Management

These regulations apply to mountain lions and coyotes and outline procedures for conducting direct and preventative PDM for the protection of big game and livestock.

2.4.4.5 Aerial Take

NMSA 17-3-47. Permit. The director of the department of game and fish may grant a permit to any person to carry out acts which are prohibited by the Airborne Hunting Act [17-3-43 NMSA 1978]. Permits shall be granted only to protect or aid in the administration or protection of land, water, wildlife, livestock, domesticated animals, human life or crops. Each person operating under a permit shall report to the director of the department of game and fish each calendar quarter, the number of birds, fishes and other animals so injured, captured or killed. Government employees are exempt.

2.4.4.6 Funding

NMSA 17-3-13.4. Big game depredation damage fund; creation; expenditure.
A. The "big game depredation damage fund" is created in the state treasury. The fund consists of appropriations made to the fund, revenues received by the department of game and fish from the sale of big game depredation damage stamps and earnings from the investment of the fund. The fund shall be administered by the department and money in the fund is appropriated to the department to carry out the provisions of Subsection B of this section. Payments from the fund shall be by warrant of the secretary of finance and administration upon vouchers signed by the director of the department or his authorized representative. Balances in the fund shall not revert to any other fund.

B. The department of game and fish shall, by rule, establish a program to correct damage to federal, state or private land caused by big game and to prevent such damage in the future. Pursuant to rules adopted by the department, expenditures from the big game depredation damage fund shall be made by the department to carry out the established program; provided that money in the fund shall not be expended for any administrative costs.

17-3-13.3. Big game depredation damage stamp required; disposition of receipts.
A. Each license to hunt big game shall include a big game depredation damage stamp. The department of game and fish shall, by rule, set the fee for the stamp; provided that the fee shall not exceed five dollars ($5.00) for each resident license or ten dollars ($10.00) for each nonresident license.
B. No license to hunt big game shall be considered to be a proper and valid license unless it indicates, by a stamp, check off or other official mark, that the fee for the big game depredation damage stamp has been paid.
C. Revenues received by the department of game and fish from the sale of big game depredation damage stamps shall be deposited to the credit of the big game depredation damage fund.

NMSA 77 ARTICLE 15. County Predatory Control Act
Allows county commissioners to establish predator control programs for the protection of sheep and goats, cattle, or both after valid petitions are received. The petitions must be signed by owners of fifty-one percent of the livestock listed on the tax rolls in the county. After approval of the petition, the county commissioners shall order a mill levy to be used for livestock protection.

NMSA 6.11.5-6. Taylor Grazing Act and Farm and Range Improvement Fund

These statutes allow Taylor Grazing Act monies collected by the United States government to be used for PDM.

NMAC 19.30.2.1-11. Procedures for NMDGF to handle depredations caused by wildlife

These sections provide information for NMDGF and private landowners on how to handle wildlife damage on private and leased lands. In essence, these set the time frames for handling wildlife complaints for NMDGF. NMDGF will provide landowners with short- and long-term solutions for depredation problems.

2.4.4.7 New Mexico Senate Bill 32: Signed April 7, 2021

AN ACT

RELATING TO WILDLIFE; ENACTING THE WILDLIFE CONSERVATION AND PUBLIC SAFETY ACT; PROVIDING FOR RESTRICTIONS ON THE USE OF TRAPS, SNARES AND POISONS; PROVIDING PENALTIES.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF NEW MEXICO:

SECTION 1. A new Section 17-11-1 NMSA 1978 is enacted to read:

"17-11-1. SHORT TITLE.--Chapter 17, Article 11 NMSA 1978 may be cited as the "Wildlife Conservation and Public Safety Act"."

SECTION 2. A new Section 17-11-2 NMSA 1978 is enacted to read:

"17-11-2. DEFINITIONS.--As used in the Wildlife Conservation and Public Safety Act:

A. "bona fide scientific research" means a research project that is not being conducted for commercial gain from the sale of animal parts and that is conducted by employees or contractors of the department or authorized by a scientific collection permit from the department;

B. "cage trap" means a trap that captures a live animal but does not grip an animal's body or body part and is not intended to kill the animal, including a live trap, a cage or box trap, a colony trap, a net and a suitcase-type live beaver trap, but does not include a corral;

C. "department" means the department of game and fish

D. "depredation trapping" means the act of setting

traps, snares or poisons on public land to reduce or prevent damage caused by wildlife to property or waterways, including harvested and stored crops and livestock;

E. "domestic animal" means any animal that is bred for and is typically subject to human control;

F. "ecosystem management" means actions that are necessary to maintain or increase the long-term sustainability and integrity of an entire system of living wildlife and their environment, including the restoration and conservation of wildlife populations and habitat, wildlife relocation, medical treatment of wildlife and the protection of threatened or endangered species;

G. "feral animal" means a domestic animal existing in an untamed state outside captivity or domestication and not under human control;

H. "government entity" means a local, state or federal government body or agency, a political subdivision of the state or an employee, agent or representative of the body, agency or political subdivision when acting within the scope of its governmental duties, but does not include an Indian nation, tribe or pueblo;

I. "leghold trap" means a spring-actuated device, either padded or unpadded, designed to capture an animal by the foot, leg or other limb, including a steel-jawed leghold trap, a padded-jaw leghold trap, a foot-hold trap, an egg trap, a duffer trap and all other similar traps;

J. "lethal body-gripping trap" means a rotating jaw trap designed to capture an animal by the body that is intended to fatally crush or otherwise kill the animal and includes conibear traps and all other similar traps;

K. "public land" means state-owned land,

state-leased land, lands held in trust by the state, lands administered by the United States fish and wildlife service, the United States forest service, the federal bureau of land management, the national park service, the United States department of defense, state parks and any county or municipality, but does not include the interior of physical structures or land belonging to or held in trust for an Indian nation, tribe or pueblo;

L. "snare" means a wire or cable with a single closing device, often with a noose, with or without stops, that is used to capture, strangle or otherwise entangle an animal, but does not include use of a catch pole, leash or tether lawfully used by a person to temporarily restrain or relocate an animal;

M. "trap" includes a leghold trap, lethal body-gripping trap or cage trap;

N. "wildlife" means a member of a vertebrate species that is native to or found in New Mexico that is not under the direct control of a human or in captivity, but does not include a feral or escaped domestic animal; and

O. "wildlife poison" means an explosive compound or deleterious substance used in a manner intended to kill wildlife."

SECTION 3. A new Section 17-11-3 NMSA 1978 is enacted to read:

"17-11-3. PROHIBITIONS ON PUBLIC LAND.--It is a violation of the Wildlife Conservation and Public Safety Act to use a trap, snare or wildlife poison for purposes of capturing, injuring or killing an animal on public land except as provided in Section 17-11-4 NMSA 1978."

SECTION 4. A new Section 17-11-4 NMSA 1978 is enacted to read:

"17-11-4. EXCEPTIONS.--The provisions of the Wildlife Conservation and Public Safety Act do not apply to:

A. the taking of wildlife with firearms, fishing equipment, archery equipment, falconry equipment or other implements in hand, when used as authorized by law;

B. the taking or control of birds, fish or rodents

not defined as furbearers in Section 17-5-2 NMSA 1978;

C. a government entity acting in the course of its official duties to prevent or mitigate actual threats to

N. "wildlife" means a member of a vertebrate species that is native to or found in New Mexico that is not under the direct control of a human or in captivity, but does not include a feral or escaped domestic animal; and

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B. the taking or control of birds, fish or rodents not defined as furbearers in Section 17-5-2 NMSA 1978;

C. a government entity acting in the course of its official duties to prevent or mitigate actual threats to human health and safety;

D. ecosystem management conducted by the department, the United States fish and wildlife service or a conservancy district of the state or its employee, agent or representative acting in the course of its official duties;

E. bona fide scientific research;

F. depredation trapping conducted by the department or a designated agent of the department using non-lethal traps or non-lethal snares, but only when accompanied by visible signs at the location of each device notifying the public of the presence of such devices;

G. the use of cage traps to recover or to provide veterinary care or husbandry to a domestic animal or feral animal as authorized by law, or to abate damages caused by any animal to property, crops or livestock; provided that:

(1) once the damage has been abated, use of the cage trap shall cease; and

(2) any captured animal is disposed of in accordance with rules established by the department or appropriate animal agency; or

H. enrolled members of a federally recognized Indian nation, tribe or pueblo when trapping is conducted solely for religious or ceremonial purposes pursuant to rules issued by the department of game and fish in collaboration with the secretary of Indian affairs and consistent with federal procedures for recognition and protection of bona fide Indian nation, tribe or pueblo religious ceremonies."

SECTION 5. A new Section 17-11-5 NMSA 1978 is enacted to read:

"17-11-5. PENALTIES.—

A. A person who violates the Wildlife Conservation and Public Safety Act is guilty of a misdemeanor. Each individual trap, snare or application of wildlife poison shall constitute a single violation of that act.

B. Any penalties under this section shall be

cumulative to any other available penalties provided by law.

C. In addition to other penalties, upon

conviction, the court may consider appropriate restitution to a state agency that incurs costs in enforcing the Wildlife Conservation and Public Safety Act."

SECTION 6. EFFECTIVE DATE.--The effective date of the provisions of this act is April 1, 2022.

2.5 WHAT PDM ALTERNATIVES ARE NOT CONSIDERED IN DETAIL?

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

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

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

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

Consistent with NEPA regulations and CEQ guidance, WS-New Mexico reviewed alternatives and ideas proposed in comments to recent APHIS-WS PDM EAs in the western region, and, in this section, identify and briefly describe those that are determined by the agency as not reasonable per the CEQ criteria, and provide the agency's rationale for not considering them in detail in this EA.

2.5.1 Use technical assistance only

WS-New Mexico would only respond to requests for assistance through providing recommendations involving lethal and/or non-lethal methods; WS-New Mexico would not conduct any operational assistance. Since this does not allow for any non-lethal operational assistance, this alternative is not considered in detail.

2.5.2 Use only lethal methods

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

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

The option to consider both lethal and non-lethal methods as part of the APHIS-WS Decision Model (Section 2 .3.1.2) allows WS-New Mexico to use the most effective and practical methods available, while accounting for the many legal, logistical, biological, ethical, and environmental variables in each unique damage situation. Finally, most members of the public that comment on APHIS-WS NEPA documents feel strongly that there be more emphasis on using non-lethal methods to resolve damages, which is already APHIS-WS policy (WS Directive 2.101).

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

2.5.3 Use of only non-lethal PDM technical assistance

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

Non-lethal technical assistance is included in Alternative 2 considered in detail in this EA (Section 2.5.2), as well as included in Alternatives 3 and 4 to a lesser degree. If the requester has taken all reasonable non-lethal actions and the problem still persists, it is not logical that the WS-New Mexico specialist would not also provide professional advice regarding effective lethal methods that are legal for the requester to use in New Mexico. Therefore, considering this alternative in detail would be redundant and would not be reasonable, logical, or professional.

Therefore, this alternative will not be considered in detail.

2.5.4 Use a bounty system for managing predator damage

APHIS-WS has no authority to establish a bounty system for population control, suppression, or extirpation. The setting of bounties occurs at the state level.

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

The circumstances surrounding the removal of animals using bounties are typically arbitrary and unregulated because it is difficult or impossible to ensure animals claimed for bounty are not taken from outside the area where damage is occurring, as most state or local level bounty legislation that exists is regional or state-wide. Bounties can become a costly endeavor, do not effectively provide relief, and may encourage fraudulent claims. Studies have also shown that participation in bounty programs do not result in effective levels of predator reduction (Bartel and Brunson 2003).

Therefore, this alternative will not be considered in detail.

2.5.5 Provide compensation for losses

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 2018(a.k.a., the 2018 Farm Bill) which is administered by the USDA, Farm Services Agency (FSA) and specifically for livestock losses due to animals reintroduced by the federal government or federally protected species (such as species protected by the ESA). Difficulties with compensation programs are discussed in Bulte and Rondeau (2005). This issue is better addressed through the political process at the county or state level.

Therefore, this alternative will not be considered in detail.

2.5.6 Livestock producers should exceed a threshold of loss before PDM actions are taken

As explained in Section 1.13.2, two independent government audits, one conducted at the request of Congress, the other conducted by USDA and based on complaints from the public and animal welfare groups, found that, despite cooperator implementation of non-lethal actions such as fencing and herding, a need exists for APHIS-WS' program of direct and sometimes lethal predator damage management activities. The appropriate level or threshold of tolerance before using non-lethal and lethal methods differs among cooperators, their economic circumstances, and the extent, type, duration, and chronic nature of damage situations (Section 1.4.3). On public lands, a history of loss may be sufficient for determining that preventative work would be appropriate. On private land, per state and federal law, the landowner/resource owner determines when the level of tolerance has been reached and may take any lethal and/or non-lethal action determined appropriate that is legal.

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

Therefore, this alternative is not considered in detail.

2.5.7 Use regulated hunting and/or trapping to reduce predator damage

NMDGF can and has used regulated 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 NMDGF. State-sponsored 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. Hunting is usually conducted in the fall and winter, when damage often occurs in the spring and early summer (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).

Under the proposed action and the alternatives that allow for technical assistance in lethal methods, WS-New Mexico may certainly recommend to NMDGF that a hunting or trapping season and an increase in regulated harvests may be helpful in reducing depredation in certain areas, if appropriate.

However, this alternative is not within the authority of APHIS-WS to implement. For all of these reasons, the use of regulated hunting and trapping is not an alternative evaluated in detail.

2.5.8 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-New Mexico would be relocated. In accordance with state law, relocation of bears and cougars must be approved by the NMDGF under specific circumstances (Section 1.7). Therefore, the relocation of bears and cougars by WS-New Mexico would only occur as directed by the NMDGF and/or as authorized by state law.

Relocating problem bears or cougars, 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. NMDGF generally does not authorize the relocation of problem predators because of the high risk of moving the problem along with the problem animal. Many smaller predators causing conflict are relatively abundant, such as coyotes, skunks, raccoons, and weasels, or are not native, such as feral cats and dogs.

However, WS-New Mexico could be requested and authorized by the NMDGF to relocate individual problem bears, cougars or other predators, as a component of any alternative that includes an active WS-New Mexico 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.

2.5.9 Manage predator populations through the use of reproductive inhibitors

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

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

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

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

Currently, no reproductive inhibitors are available for use to manage most large mammal populations (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-New Mexico would neither use nor recommend the use of reproductive inhibitors to reduce or prevent reproduction in mammals responsible for causing damage. Use and effectiveness of reproductive control as a wildlife population management tool is limited by population dynamic characteristics, such as longevity, age at onset of reproduction, population size, and biological/cultural carrying capacity; habitat and environmental factors such as isolation of target population, cover types, and access to target individuals); socioeconomic; and other factors.

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

2.5.10 Use only non-lead ammunition

Effects on various resources from the use of lead ammunition are discussed in Section 3.10.2 of the EA. APHIS-WS' use of lead ammunition is a small fraction of total lead contamination from many sources.

In 2020, WS completed a detailed risk assessment (in the process of being peer reviewed) of the agency's use of lead in wildlife damage management. The assessment was peer reviewed and provided an in-depth look at lead use by analyzing the potential exposure to human health, ecological, aquatic and terrestrial environments. The assessment concluded that WS' lead use would result in negligible risks to human health and the environment. WS abides by federal and state laws related to lead ammunition and continues to use non-lead ammunition in wildlife damage management where feasible and effective. WS remains committed to working with other federal and state agencies to proactively manage lead exposure to fish and wildlife. With this goal, WS anticipates risks to humans and the environment will continue to decrease.

WS selects ammunition for each project based on site specific conditions and concerns. Manufacturers continue to make improvements in the performances of non-lead ammunition and WS evaluates them for our operational needs. However, ammunition does not perform universally, even across firearms of the same make and caliber and reliability is necessary for safe and effective WDM. The extent to which WS can incorporate the use of non-lead ammunition is contingent upon the project specific performance involving four factors; 1) human safety 2) humanness 3) environmental impacts 4) availability/ cost.

1) Human Safety

   - Protection of human safety during operations is always of the utmost importance. The use of firearms has inherent risk; therefor, ammunition selection must decrease those risks to the extent possible. Due to decreased frangibility, non-lead ammunition has a greater tendency to pass through an animal, increasing the possibility of hitting an unintended target.
   - When WDM is necessary in urban areas, WS must ensure that the ammunition used will accurately and reliably hit the target with the lowest probability of passing through. Non-lead ammunition may be selected where a suitable round and compatible firearm is identified through testing for the specific project.
   - In urban or airport environments, maximum accuracy is necessary to completely incapacitate an animal as to prevent it from becoming a human safety risk.
   - During aerial operations for certain species, WS has found that decreased efficacy of non-lead ammunition requires increased shots to incapacitate the target. This results in increased low level aerial operations. Increasing the time an aircraft conducts aerial operations inherently increases risks to human safety.

2) Humaneness

   - Non-lead bullets do not transfer energy upon impact as efficiently as lead, resulting in a less-lethal projectile. Bullets that pass through a target, instead of expanding or breaking apart also transfer less energy to the target. Both scenarios reduce the humaneness of the kill.
   - Non-lead shot varies significantly in density and hardness which can result in less energy transfer and/or less overall penetration to the target and potentially reducing humaneness.
   - Where ammunition has a greater probability of producing sub-lethal injuries, multiple shots are needed to cause death, which decreases humaneness.

3) Environmental Impacts

   - WS acknowledges that there may be risks to nontarget birds and mammals that consume lead in carcasses of dead animals. However, the risk assessment determined that WS's use of lead ammunition poses only a negligible threat and would not have any population level effects on terrestrial species. WS considers the site specific effects of lead where there are increased risks to sensitive wildlife, such as federally listed species, and selects non-lead ammunition where there is the potential for adverse impacts or as required by ESA consultation.

- Similarly, the risk assessment determined the small amounts of lead that may be present in the environment as a result of WS activities would not have an adverse impact to soil, air or water quality.
- Environmental risks from WS lead ammunition use are minor and will decrease as WS continues to incorporate non-lead ammunition where appropriate.

4) Availability/Cost Effectiveness
   - Due to the unique nature of WS operations, ammunition must meet criteria for safe and effective use. Non-lead ammunition is generally manufactured for recreational hunting and shooting needs and does not always meet WS specific performance requirements for specialized needs such as aerial shooting.
   - Market availability of ammunition that meets WS standards for humaneness and safety in the necessary quantities continues to be a challenge. Nationwide, WS must operate in a wide variety of unique circumstances. A one size fits all approach to ammunition is not appropriate, and the program must remain flexible in ammunition selection to ensure safe and humane operations.
   - Non-lead ammunition that meets WS specific requirements for safe, effective and humane use is currently 2-4 times more expensive than lead, increasing costs associated with WDM and also results in less value for cooperator dollars.

WS continues to dedicate resources and seek additional applications for non-lead ammunition in WDM activities. WS recognizes that non-lead ammunition is more available and more reliable than in previous years, and we expect the performance and availability of non-lead alternatives to continue to improve. We will continue to evaluate available ammunition to ensure our operations remain safe and effective, while having as little effect on the environment as necessary.

2.5.11 Conduct short-term suppression of populations with the goal of long-term eradication.

An eradication alternative would direct all WS-New Mexico's program efforts toward long-term elimination of selected predator populations wherever a cooperative agreement has been initiated with WS-New Mexico. Eradication of a native predator species is not a desired population management goal of state or federal agencies and is outside the authority of APHIS-WS. WS-New Mexico does not consider eradication or suppression of native wildlife populations a responsible or effective strategy for managing predator damage because APHIS-WS policy and authority is to manage offending animals or multiple animals within the area of damage. NMDGF has the authority to manage population levels of regulated species of wildlife through hunting and trapping seasons and depredation permits. WS-New Mexico may assist NMDGF for meeting specific NMDGF management objectives when requested (Section 1.8.1), but that type of activity is generally in small areas for protection of specific subpopulations of selected game animals consistent with NMDGF management objectives set with public input (Section 1.11.5).

Therefore, this alternative will not be considered in detail.

2.5.12 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 (Section 1.11.3). 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. In addition, 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).

However, several studies have indicated that providing supplementary feeding for bears damaging trees may reduce actual damage in commercial timber stands (Nolte and Veenendaal 2002, Ziegltrum 1994). Despite the supplemental feeding, some of those bears may still damage trees, and some stands can suffer substantial damage. Therefore, lethal removal of individual bears may be needed to complement supplemental feeding. Those implementing a supplemental feeding method for bears in commercial timber stands must be committed to long-term use of the method, which for some cost may be prohibitive. This method is included in Alternatives 1, 2, and 3, as described in Sections 2.3.1, 2.3.2, and 2.3.3, and may be recommended to a cooperator.

Therefore, this alternative is not considered in detail.

2.5.13 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-New Mexico is not authorized to conduct this type of work and would not use this method for PDM.

Therefore, this alternative is not considered in detail.

2.5.14 Use lithium chloride as an aversion agent for coyotes depredating 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-New Mexico or NMDGF, and therefore cannot be used or recommended for this purpose. If a product containing lithium chloride is registered in New Mexico 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-New Mexico considers using a product containing lithium chloride, WS-New Mexico would update its NEPA analysis accordingly.

Therefore, this alternative is not considered in detail.

2.5.15 Losses are confirmed by an independent entity other than WS-New Mexico

Some commenters request that all livestock losses be confirmed by an entity independent of WS-New Mexico prior to WS-New Mexico 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 New Mexico, other than commercial enterprises that focus on predators less than or equal to the size of coyotes.

In addition as coyotes are not regulated in New Mexico, private landowners or managers may take predators in protection of property on private or public land. This requirement is also outside the scope of this EA as WS-New Mexico has no authority to implement an independent process for verifying livestock losses.

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

Therefore, this alternative will not be considered in detail.

2.5.16 Producers avoid grazing livestock in areas of know predator activity and insure herders are 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-New Mexico 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.

Although WS-New Mexico might recommend that strategy as part of technical assistance using the APHIS-WS Decision Model, it does not have authority to require ranchers to hire herders for livestock. 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-New Mexico 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 and range riders (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 PDM process would be used by WS-New Mexico under alternatives that involve some level of WS-New Mexico involvement in PDM.

2.5.17 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, may be extremely dangerous.

Therefore, this alternative is not considered in detail.

2.5.18 Livestock producers pay 100% of WS-New Mexico's assistance involving lethal PDM.

This is discussed in Section 1.13.6.3. The intent of this alternative is to ensure that lethal removal is not subsidized by federal taxpayer funds, thereby encouraging livestock producers to decide whether their funds are more effective if applied to non-lethal methods.

Under all alternatives in which WS-New Mexico provides lethal and/or non-lethal assistance, preference is already given to non-lethal methods in accordance with WS Directive 2.101. In many instances, WS-New Mexico is contacted after entities have unsuccessfully attempted to resolve their damage or threats on their own with non-lethal and/or lethal methods. APHIS-WS is authorized by federal law and funded by both Congressional appropriations and funds provided by entities that enter into cooperative agreements with APHIS-WS state offices for assistance.

WS-New Mexico already provides technical support to all requesters and operational support (Alternative 1), including lethal assistance to some degree under all alternatives as determined appropriate, except Alternative 5.

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

2.5.19 WS-New Mexico prohibited from operating on public lands.

The USFS and BLM recognize the importance of effective PDM actions on lands under their jurisdiction. USFS and BLM maintain MOUs with APHIS-WS at the national level (Section 1.8.2). These MOUs provide for direct requests from livestock permittees or state agencies to the respective APHIS-WS state agency for preventive and corrective assistance.

Per the national interagency MOUs, the agencies meet annually to cooperatively develop work plans, including designating appropriate restrictions to ensure that PDM actions do not conflict with land use plans.

Producers leasing grazing allotments on federal lands, natural resource managers working to protect sensitive or ESA-listed species, and federal agency officials responding to threats to human/pet health or safety associated with predators on federal lands that they manage have legal access to the same types of damage management methods as would be used by WS-New Mexico, with the exception of the Livestock Protection Collar.

PDM can and is being conducted on federal lands by entities other than WS-New Mexico. Public hunting and trapping as regulated by NMDGF legally occurs on public lands unless otherwise restricted (such as in National Wildlife Refuges).

Some predator species, such as coyotes, may be taken by the public, permittees, or other agencies experiencing depredation in the same manner as actions by WS-New Mexico (except for the use of LPC's) without any requirement to report take to NMDGF, unless they are taken under an aerial shooting permit issued by NMDGF. Depending on the training and experience of the individuals conducting the work, selectivity of these actions for target species and target animals, especially older territorial adult coyotes that are typically more difficult to capture than younger individuals, may be lower than for a program conducted by trained personnel from WS-New Mexico (Sacks et al. 1999, Larson 2006).

This issue is outside the scope of APHIS-WS authority. Therefore, this alternative is not considered in detail in this EA.

2.5.20 No PDM within any designated Wilderness Areas or Wilderness Study Areas.

WS-New Mexico has not conducted PDM activities in wilderness or WSAs between FY15 and FY19 but may receive requests for assistance (Alternative 1; Sections 2.3.1 and 3.11). The level of PDM activities that is expected to occur in designated wilderness areas, proposed wilderness areas, and WSAs is either none, or so minor that the effects of any of the alternatives that involve no WS-New Mexico 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 New Mexico have historic grazing allotments. The minor amount of PDM activities that could be conducted by WS-New Mexico in wilderness, proposed wilderness, or WSAs conforms to legislative guidelines, MOUs and access approval letters (USFS 2017) between APHIS-WS and the responsible land management agencies.

WS-New Mexico and the land management agency meet annually to review work plans that delineate what, when, why, where, and how PDM 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).

As evaluated in Section 3.11, 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.

Authorization for PDM on WAs and WSAs is determined by statutes and policies under the authority of USFS and BLM. Additionally, this alternative does not meet the purpose and need. Therefore, this alternative is not considered in detail.

2.5.21 WS-New Mexico contracts PDM activities to the commercial sector or defers all PDM activities to NMDGF or NMDA.

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

NMDGF is often the first to be requested and to respond to damage caused by bears and cougars, and can either do the work itself, use private hunters with pursuit dogs or request WS-New Mexico. Any PDM work not conducted or authorized by WS-New Mexico or by another federal agency would not require compliance with NEPA.

WS-New Mexico does not contract its authorized activities to other entities, including commercial entities. WS-New Mexico would not assume any responsibility or liability for actions conducted by any other entity.

Therefore, this alternative will not be considered in detail.

2.5.22 Modify habitats to reduce predation.

WS-New Mexico may recommend habitat modification as part of its technical assistance activities (WS-New Mexico does not conduct this type of activity itself) in all alternatives having WS-New Mexico involvement. The land/resource owner is responsible for ensuring that any necessary permits are acquired prior to taking any such action on their private land. Also, federal and state land management agencies have the authority to conduct habitat management.

As this strategy is already included in all the alternatives considered in detail, except the "No Program" alternative (Alternative 5), this alternative will not be considered further as an independent alternative.

2.5.23 Make supplemental payments to livestock producers: Marin County, CA Experiment.

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 program is described in more detail under Section 1.13.5.

Animal advocates have referred to the Marin County program as "a model program" that has successfully addressed and embraced ethical concerns, as well as the differing values of the ranching and animal protection communities (Fox 2001, Fox 2006). However, this positive opinion of the County program is not necessarily shared by Marin County or the greater California livestock community (Larson 2006). Although Marin County's program is championed by some groups as a non-lethal approach and appears to be less lethal on its surface, a study evaluating the effectiveness of the Marin County program (Larson 2006) indicated that more coyotes have been killed during the implementation of the Marin County Program compared to the standard APHIS-WS cooperative program. This is due, in part, to the fact that landowners are not prohibited from killing coyotes on their land or hiring others to do so while also participating in the County's program. Individual producers and others working on their behalf routinely practiced snaring, calling and shooting, and denning in an effort to kill damage-causing coyotes. Larson (2006) also indicated that it is likely that some ranchers are taking more coyotes than when the WS-California program was in place, because WS-California personnel target the more difficult to remove dominant, offending coyote while efforts by untrained individuals often remove more juvenile and subordinate coyotes which are less likely to cause lamb losses (Sacks et al. 1999).

Research conducted in nearby Mendocino County, California, and elsewhere indicates that territorial, dominant (alpha) coyote pairs, the most difficult to capture by snaring or trapping, cause the majority of livestock losses, especially when adults are raising pups (multiple authors cited in: Jaeger 2004, Sacks et al. 1999). Experienced field specialists from APHIS-WS are likely to be more effective at targeting specific problem coyotes than less experienced members of the public who are more likely to remove less problematic, but easier to capture or kill, juvenile and subordinate coyotes (Larson 2006). In addition, landowners are rarely trained, experienced experts in professional trapping techniques and are more likely to capture non-target species during their efforts (Larson 2006). Because the Marin County program requires no records to be kept or submitted from landowners on use of lethal methods or take numbers, there is no way to quantify the take of target and non-target animals nor evaluate the environmental impacts of such take. The APHIS-WS program uses the MIS database to effectively track the equipment, and target and non-target take associated with all operational PDM projects.

A review of Marin County's budget over the first five years of the non-lethal program's implementation found that on average the program cost Marin County 1.3 times the amount that the cooperative APHIS-WS PDM program cost the county in its highest year (et al. Larson 2016). This budget evaluation only recorded the county's cost for implementation, and do not capture the additional landowner costs associated with this program. The discontinuation of the indemnity compensation program and the limited scope of producers served for this amount are also noteworthy.

The scope of the Marin County program is limited to providing financial compensation assistance for non-lethal predator damage management to protect livestock and poultry operations larger than a certain size. It does not provide trained personnel to apply this cost-shared equipment in the field or address several of the needs for action that WS-New Mexico work on as identified in Chapter 1, including protecting smaller herds of livestock, property protection, work at airports, for public/pet health or safety, or to protect natural resources, including ESA-listed species (Sections 1.11.2 through 1.11.5), nor do non-lethal methods always resolve the predator management problem, even for operations that do qualify for cost-share assistance. Unlike New Mexico, Marin County does not have prevalent cougar or black bear populations or conflicts with these species and livestock. Between 1972 and 2015, only 4 depredation permits were issued for cougar in Marin County and none were taken (CDFG 2015; https://www.wildlife.ca.gov/Conservation/Mammals/Mountain-Lion; viewed 09/25/2017).

Similarly, between 2006 and 2014, no permits were issued for black bears in Marin County (CDFG 2015; https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=112007&inline; viewed 09/25/2017). In contrast, NMDGF averaged about 163 complaints per year combined for bear and cougar across the state. WS-New Mexico recorded an annual average take of 4.2 cougars and 1.4 bears statewide between 2015 and 2019.

The Marin County program is limited to providing financial compensation assistance with non-lethal predator damage management to protect sheep operations larger than a certain size. It does not address several of the needs for action that WS-New Mexico work on as identified in Chapter 1, including protecting cattle and calves, work at airports, for public/pet health or safety, or to protect natural or commercial resources, including ESA-listed species (Sections 1.12.2 through 1.12.5), nor do non-lethal methods always resolve the predator management problem, even for sheep operations.

Based on the limitations of the Marin County program summarized above, the failure of the program to address all needs for action presented in Chapter 1, and the fact that APHIS-WS has no control over the authorities, decisions, and budget of state, county, and local governments, WS-New Mexico has determined that detailed analysis of this alternative would not provide substantive new information to aid decision-making and will not be conducted at this time.

2.5.24 WS-New Mexico should subsidize non-lethal methods implemented by resource owners.

Under the current program (Alternative 1), WS-New Mexico provides some subsidies for some non-lethal PDM methods in the form of loaning or distributing equipment, under very limited circumstances. For example, propane cannons, pyrotechnics, and cage traps have been loaned or distributed by WS-New Mexico to livestock producers on rare occasions. This activity is also incorporated into Alternatives 2 and 3. The "subsidy for non-lethal methods" alternative could include covering the cost of livestock guarding animals, purchasing materials for non-lethal methods (e.g., fencing or fladry), staffing range riders to protect livestock at night, and loaning or permanently provisioning frightening devices (e.g., pyrotechnics or electronic guards).

Although we recognize the appeal of this alternative, unfortunately it has some limitations. Cooperators rely on WS-New Mexico for PDM, which includes both non-lethal and lethal methods. At present, cooperators often purchase and utilize non-lethal methods prior to contacting WS-New Mexico to address PDM needs. Subsidies for non-lethal methods that cooperators can and are already implementing would not be an efficient and cost effective use of public resources when there is a need for WS-New Mexico's assistance with lethal methods.

Additionally, non-lethal PDM methods are extremely limited for some applications (e.g., predation on range herds of cattle), and, in some cases, predation persists despite implementation of practical and effective non-lethal methods. Most often, WS-New Mexico's assistance is requested once predation has reached the cooperator's threshold of losses and non-lethal methods have been proven ineffective.

WS-New Mexico is a cooperatively funded program with the majority of its funding comprised of non-appropriated (non-federal) dollars. Cooperators provide the direction to WS-New Mexico on the types of services they want delivered with the funding they provide and it is implemented in accordance with program policies. Although WS-New Mexico does occasionally loan some harassment equipment, cooperators request that WS-New Mexico focus its efforts on those services that the public is less skilled or proficient in doing. Cooperators rely on WS-New Mexico to provide technical assistance needed for individuals (including individuals supplementing WS-New Mexico efforts) to use their own resources and efforts. Use of appropriated dollars to subsidize the purchase of non-lethal methods would impact the support infrastructure which enables other entities to cooperate with WS-New Mexico. The State of New Mexico also provides no subsidies for non-lethal methods to resolve damages from the predator species covered in this EA. Subsidies for purchase of non-lethal methods to selected types of livestock producers is currently offered in Marin County, California by the County to some degree, but the costs and effectiveness are not clearly known (Shwiff et al. 2005, Shwiff et al. 2006; Sections 1.13.5 and 2.5.24).

Given that WS-New Mexico does not have the anticipated resources needed to fully implement this alternative statewide and that WS-New Mexico would not be able to adequately meet the full purpose and need for action, a "subsidy for non-lethal methods" alternative will not be analyzed in detail.

2.5.25 Suspend lethal removal of predators to protect livestock until more rigorous scientific testing shows individual methods to be effective at reducing predation.

Some people have questioned the efficacy of lethal tools and techniques to manage livestock predation and are opposed to their use. A recent paper published in Frontiers in Ecology and the Environment criticizes certain research on lethal predator damage management 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 study designs that use the same standards as those in controlled laboratory settings for biomedical research. We do not agree with Treves et al.'s assessment that existing research is flawed. Further, field studies and laboratory studies require different study designs. We found Treves et al.'s critique contained serious errors in interpretation of well-established field-study designs. We believe it would be irresponsible to limit the ability of WS managers and trained experts to effectively resolve predator damage issues based on this paper.

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. APHIS-WS scientists address and acknowledge these variabilities using well-established and recognized field study designs, such as the switch-back and paired block designs. Treves et al.'s critique of at least two Wildlife Services' studies did not accurately interpret or represent the studies' designs or results and raises questions regarding additional misrepresentations and errors in the paper.

APHIS Wildlife Services agrees that predation damage management tools and techniques must be based on rigorous, scientifically-sound principles. Researchers at NWRC are dedicated to gathering information, testing new ideas and methods and using experiments (versus observational studies) as much as possible. APHIS-WS scientists at NWRC's 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 findings are published in peer-reviewed literature.

APHIS-WS bases its management recommendations and decisions on the use of a structured decision model as part of integrated wildlife damage management (IWDM). Wildlife Services, as well as state and federal agencies resolve wildlife damage issues by applying this model. The model encourages the use of a variety of methods and tools (both non-lethal and lethal) for resolving wildlife conflicts. These methods are continuously reviewed, tested, and evaluated to ensure they are safe, effective, environmentally sound, and feasible.

Predators and other native wildlife are valuable resources and important members of our natural ecosystems. Wildlife Services' policies and decisions are based on the best available science. Our goal is to reduce local damage, not to manage predator populations. Thus, WS-New Mexico's actions focus on the individual animals causing damage. Our experts work hard to balance the needs of wildlife and people and continue to find and encourage the use of the most effective, safe, environmentally sound and practical methods for use in predation damage management.

CHAPTER 3 ENVIRONMENTAL CONSEQUENCES

WS-New Mexico conducts PDM on many land classes (Sections 1.9.4 and 2.3, Table 2.2) using a variety of lethal and non-lethal methods (Section 2.3.1, Appendix A) when requested to assist with damage and threats caused by predators. Chapter 3 first identifies the types of impacts (effects) that will be evaluated, environmental resources that will be studied, and what would occur if WS-New Mexico were less available to provide PDM assistance. Each issue section addresses a separate environmental resource, and includes background information, an evaluation of the impacts on that resources, and a conclusion. The alternatives are compared with the environmental consequences of the proposed action at the end of each issue section. Determination of significance of the impacts predicted in this chapter does not occur in this EA, but is made by the APHIS-WS decision maker documented in the appropriate decision document.

3.1 WHAT KINDS OF EFFECTS ARE EVALUATED IN THIS CHAPTER?

Chapter 3 examines the direct, indirect, and cumulative impacts of each of the alternatives on the biological, physical, and sociocultural aspects of the human environment (issues). Direct effects are caused by the action and occur at the same time and place. Indirect effects, which are caused by the action and are later in time and farther removed in distance (40 CFR §1508.8). A cumulative impact 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). Thus, the baseline impacts are those for Alternative 1, the proposed action/no action alternative, as described in Section 2.3.1.

New Mexico Senate Bill 32 (Section 2.4.4.7) impacts several operating policies on how WS-New Mexico will conduct PDM on public lands compared to the baseline past actions. Section 2.4.3.4 outlines the policies WS-New Mexico will implement to comply with senate bill 32. WS-New Mexico's implementation of these operating policies will go into effect when the decision document is signed for this EA, or no later than the Senate Bill 32 deadline of April 1, 2022. Although some of the methods used in the past are now restricted on public land, WS personnel will still be able to effectively conduct PDM by selecting other legally available methods. The environmental impacts of WS-New Mexico's baseline PDM actions on public lands are not expected to significantly change.

3.2 WHAT ISSUES ARE ANALYZED IN THIS CHAPTER?

Environmental issues are the resources that may be affected by the proposed action, or concerns about the risks to humans from implementing PDM activities. The issues in this section were identified based on APHIS-WS experience, agency and tribal outreach, and/or from public comments on similar APHIS-WS actions. Many of the issues are evaluated in greater detail than the expected effects warranted because they are concerns that have been commonly raised by the public during similar APHIS-WS NEPA processes (United States Department of Agriculture - Animal and Plant Health Inspection Service - Wildlife Services 2011;2014a;2016). The following issues are analyzed in this chapter in the order outlined.

1. Impacts on Target Species

This issue drives the analysis of the direct effects of WS-New Mexico's intentional lethal PDM activities, and the cumulative effects that include all other known sources of predator mortality. WS-New Mexico, its cooperating agencies, and the public are concerned with the effects of removals on the viability of predator populations. The effects on each species is evaluated using the best available information including the scientific literature and detailed take information from WS-New Mexico's MIS database and reported take from NMDGF databases. Analysis of this issue is provided in Section 3.5 of the EA.

2. Impacts on T&E Species and other Non-target Species

2.1. Impacts on ESA-listed Threatened and Endangered Species

WS-New Mexico consults with the USFWS when its activities may affect any federally-listed threatened or endangered species. This issue evaluates the potential for effects on such listed species. ESA Section 7 consultations with the USFWS are relied on for evaluating potential effects. WS-New Mexico has also consulted with NMDGF to determine whether our actions are consistent with the survival guidelines for state listed Threatened or Endangered species. Analysis of this issue is provided in Section 3.6 of the EA.

2.2. Impacts on Other Non-target Species

Analysis of unintentional lethal and non-lethal take of predators and other species, formerly referred to as non-target take, is based on WS-New Mexico take data and evaluated within the context of their population trends. Analysis of this issue is provided in Section 3.7 of the EA.

3. Potential for WS-New Mexico PDM Activities to Contribute to or Cause Ecological Trophic Cascades

This issue has been routinely raised during APHIS-WS NEPA public comment periods and is based on a concern that the removal of predators during PDM may cause an indirect ecological chain of events to occur within and through different trophic levels (levels of the food chain). Complex interrelationships exist among and between trophic levels, population dynamics, habitat, biodiversity, and the species themselves. This analysis is based on an extensive review of the relevant scientific literature and impact analyses on predator and non-predator species in New Mexico (Issues A and B). Analysis of this issue is provided in Section 3.8 of the EA.

4. Humaneness and Ethics of WS-New Mexico PDM methods

WS-New Mexico and the public are concerned about the humane treatment of animals, and people hold differing ethical values related to PDM. The scientific literature related to the ethics of wildlife capture and lethal take in recreational, research, and predator control activities, and the apparent humaneness of the use of mechanical, non-chemical, and chemical lethal and non-lethal take methods are summarized, discussed, and analyzed. Analysis of this issue is provided in Section 3.9 of the EA.

5. Impacts of PDM Methods on the Environment and Their Risks to Human/Pet Health and Safety

This issue drives the analysis of the effects of WS-New Mexico's use of PDM methods (mechanical, non-chemical, and chemical methods, Appendix A) on environmental resources including soil, water, air, plants, and invertebrates. It also assesses the risks from using the PDM methods on human and pet health and safety. Analysis of this issue is provided in Section 3.10 of the EA.

6. Impacts on Special Management Areas

Analyses of impacts related to PDM actions in special management areas in New Mexico focuses on understanding the types of activities allowed in special management areas with an emphasis on Wilderness Study Areas and congressionally-designated Wilderness. The evaluation includes discussion of how proposed PDM activities in Wilderness and other specially managed lands would be found to be consistent with the objectives for each special management area. Analysis of this issue is provided in Section 3.11 of the EA.

3.3 WHAT ISSUES ARE NOT CONSIDERED IN DETAIL AND WHY?

The following issues have been raised by commenters on other APHIS-WS documents, but are not considered in detail for the reasons identified:

- ***APHIS-WS activities could conflict with ongoing wildlife field research:*** Concerns that APHIS-WS PDM activities could interfere with ongoing agency or academic wildlife research have been raised. WS-New Mexico coordination with NMDGF, tribal, federal, or state agency researchers would typically identify such ongoing research so potential conflicts could be avoided or mitigated. Such research occurring on USFS or BLM lands would also be identified during development of the Annual Work Plan.

- ***Accuracy of reporting intentional and unintentional take of animals:*** Commenters have questioned the accuracy of APHIS-WS recording of the number of animals taken intentionally and unintentionally during field activities. All APHIS-WS personnel are required to accurately report their field activities and technical assistance work in the MIS database, including all animals taken intentionally and unintentionally, whether lethally or released (WS Directive 4.205). Per APHIS-WS policy, 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 activities reviewed the accuracy of recording field activities, among other issues (Section 1.12.2). The audit concluded that APHIS-WS complied with all applicable federal and state laws and regulations regarding wildlife damage management. However, the audit found that MIS contained inaccurate information, including external party access and data entry errors. These conditions resulted in inflated wildlife control numbers and the transmission of inaccurate data to the public. APHIS-WS is committed to and actively addressing OIG recommendations intended to further reduce discrepancies (OIG 2015).

- ***Environmental effects from the loss of individual animals:*** Comments on previous PDM EAs have urged APHIS-WS to analyze environmental impacts from the loss of individual animals suggesting that the killing of any wildlife represents irreparable harm. Under the current and proposed alternatives, an individual predator or multiple predators in a specific area may be lethally removed through WS-New Mexico PDM activities. All WS-New Mexico PDM activities are conducted under the authorization of and in compliance with federal and state laws for the protection of wildlife populations. Although we recognize that some people could find the loss of individual animals distressing, analysis in Chapter 3 indicates the current and proposed actions involving the removal of individual animals would not in any way cause direct, indirect, or cumulative irreparable harm or other environmental impacts on any of the wildlife populations involved in WS-New Mexico's operations, including ESA-listed species (see Sections 3.5, 3.6, and 3.8). Section 1.4.2 discusses the variety of values that people place on wildlife, including on individual animals. The ethics and humaneness of capture and removal of individual animals are evaluated in detail in Section 3.9.

In addition, the following environmental resources are not evaluated in detail because the agency has found that these resources are not significantly impacted by the APHIS-WS program and WS-New Mexico operations, based on previous PDM EAs prepared in the Western United States and in New Mexico.

- ***Cultural resources:*** Predator damage management methods and activities implemented by WS-New Mexico as described in Section 2.3.1 and Appendix A do not cause major ground disturbance and generally do not have the potential to affect historic properties, districts, sites, and objects. WS-New Mexico has determined that its activities do not generally have the potential to affect historic properties and other cultural resources and are therefore not "undertakings" as defined by the National Historic Preservation Act (NHPA). In addition, as described in Section 1.8.2, WS-New Mexico closely coordinates all activities with land managers, including land management agencies who are responsible for identifying areas of potential conflict and avoidance. Therefore, NHPA consultation requirements have not been triggered based on past WS-New Mexico activities. In the unlikely event that an issue with cultural resources is raised during PDM planning by a Tribe or Federal agency, or if WS-New Mexico were to identify a localized need to excavate soil, or have another potential effect on historic buildings, sites, or objects, NHPA could be triggered and WS-New Mexico would review its activities with the SHPO to determine the appropriate consultation needs. However, in these unlikely scenarios, WS-New Mexico would likely relocate its site activities to completely avoid any potential effects on cultural resources.

- ***EO 12898 Environmental Justice*****:** This executive order relates to the fair treatment of people of all races and income levels with respect to social, health, and environmental impacts. WS-New Mexico responds to all requests for assistance, regardless of race or level of income, and the contribution of federal funds can further assist such populations in addressing health and safety threats caused by predators and economic impacts from depredation and damage. Disposal of carcasses, and handling, use, and disposal of hazardous materials and chemicals are conducted per agency policy (Section 2.4) and federal and state law and regulations. Risks to human health and safety are discussed in Section 3.10.

- ***Floodplains (E.O. 11988):*** WS-New Mexico 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-New Mexico operations do not change the visual quality of a public site or area. Although physical structures, such as fencing, may be recommended as part of technical assistance, they are not constructed by WS-New Mexico and therefore not under the agency's jurisdiction. WS-New Mexico may assist livestock producers with installing temporary fencing or fladry in small quantity as a non-lethal deterrent to predators and would be more likely to occur on private land but could occur on active grazing allotments on public land. These temporary barriers would be for short duration.

- ***General soils*** (except for Issue 3.10.2 - environmental fate of lead in soils): WS-New Mexico 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 as required by land management agencies, landowners, or by law, 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-New Mexico operations do not involve any major excavation, blasting, or contact with minerals or change in the underlying geology of an area.

- ***Prime and unique farmlands:*** WS-New Mexico operations do not involve converting the land use of any kind of farmlands.

- ***Water resources*** (except Section 3.10 regarding the use of lead ammunition and effects in wetlands)***:*** WS-New Mexico operations do not involve construction, major digging, dredging or filling, discharge of pollutants into waters of the U.S., or changes to flow of waterways. All chemicals used for PDM are used, stored and disposed of in accordance with EPA and state requirements for the protection of the environment. WS activities would not cause erosion or sedimentation into water bodies. See also general soils and vegetation in this section. Therefore, PDM would not affect water resources including water quality and wetlands, streams, ponds, or other water bodies.

- ***Air quality:*** WS-New Mexico's emissions are from routine use of vehicles, 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.

- ***Vegetation*****, including timber and range plant communities (except for federally-listed plant species, Section 3.6)*****:*** WS-New Mexico operations do not involve modification to any vegetation communities, nor do they involve removal of trees or shrubs. WS-New Mexico's activities would have only a small potential for a negligible amount of plant disturbance (see Section 3.6.5 for a discussion of effects on T&E plant species). WS-New Mexico may provide technical assistance in the form of information or advice to land managers/owners to modify vegetation to help deter predators, however actions by the land managers/owners are not a WS-New Mexico responsibility.

- ***Climate change:*** Greenhouse gases (GHGs) are components of the atmosphere that trap heat relatively near the surface of the earth, and therefore contribute to the greenhouse effect and global warming. Most GHGs occur naturally in the atmosphere, but increases in their concentration result from human activities such as the burning of fossil fuels. Global temperatures are expected to continue to rise as human activities continue to add carbon dioxide, methane, nitrous oxide, and other greenhouse (heat-trapping) gases to the atmosphere.

The most recent report by the Intergovernmental Panel on Climate Change (IPCC 2014) states that it is *extremely likely* [emphasis in text] that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the human-caused increase in greenhouse gas (GHG) concentrations and other human-caused contributions together. This report states that climate change impacts are strongest and most comprehensive for natural systems, causing changes in precipitation levels, timing, and extremity; water quality, quantity, and timing; seasonal timing of life cycle activities, migration patterns, geographic ranges abundance, and interactions of terrestrial, aquatic, and marine species; ocean acidification; temperature extremes; and increases in high sea levels. Continued emissions of GHG will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems.

In 2016, the President's Council on Environmental Quality (CEQ) advises federal agencies to consider whether analysis of the direct and indirect GHG emissions from their proposed actions may provide meaningful information to decision makers and the public during NEPA analyses (CEQ Final Guidance 2016). This guidance has been recently rescinded. However, even if the guidance were in effect, WS-New Mexico's impacts on climate change from its greenhouse gas emissions are *de minimus*.

The potential effects of climate change on populations of predators has been considered in Section 3.5.

3.4 HOW WILL ALTERNATIVES BE ASSESSED WHERE WS-NEW MEXICO ACTIVITIES ARE MODIFIED OR ABSENT.

Alternative 1 involves continuing the current WS-New Mexico PDM activities/proposed action as described in Sections 2.3.1. Alternatives 2 through 5 modify the levels of WS-New Mexico involvement in PDM activities in New Mexico to differing degrees. A summary of the issues by alternative is presented in Table 3.22 (Section 3.12).

An important part of comparing the environmental impacts and risks to human health and safety of the alternatives is understanding what PDM may be implemented when WS-New Mexico has limited or reduced abilities to respond to requests for assistance with a full array of legally available methods applied using the APHIS-WS Decision Model. To address this factor, this section provides information on who can and does implement PDM, and how those activities are likely to compare with WS-New Mexico's proposed action, its impacts and risks.

3.4.1 What other entities could respond if WS-New Mexico activities are modified or absent?

Multiple agencies, other entities, and individuals can conduct PDM activities:

- NMDGF can either conduct PDM directly for game animals or issue a permit for others to take game animals for reducing damage outside of regular game seasons, all of which are reported to NMDGF;

- NMDGF can issue permits for aerial shooting of coyotes to private or commercial entities, with each permit issued for specific circumstances and time periods, and reporting of take required;

- Wildlife control operators (WCOs) can provide commercial services to anyone as requested, and their take is reported to NMDGF at the end of each year;

- Landowners or authorized agents may take predators causing damage or risks on private land in accordance with state law (Section 2.4.4.1), with NMDGF requirement for reporting take dependent on species taken (no reporting is necessary for take of coyotes, for example); and

- WS-New Mexico may provide PDM services when requested on any land class, either directly or as an agent of NMDGF, including technical advice on lethal and non-lethal methods and implementation of lethal methods, and keeps detailed records of take in its MIS database.

- Table 3.1 provides a conservative estimate of intentional lethal take by WS-New Mexico directly taken by or reported to NMDGF by other entities for each species. The largest lethal take of predators is by non-WS-New Mexico entities during NMDGF-regulated game and furbearer seasons. This take, however, does not directly address damage and risk situations caused by predators.

- WS-New Mexico conducted approximately 51% of its PDM activities on private land during FY 2015- FY 2019 WS-New Mexico also responds to requests for PDM activities on federal land (USFS and BLM) and other public lands, including city, county, and state lands (Table 2.2). In the absence of WS-New Mexico, government, private entities and landowners, could request assistance from any available local commercial WCO and, in the instance of cougar and bear depredation, NMDGF. NMDGF may or may not have the resources available to respond to every request for assistance. Land owners and their agents may also attempt to respond to damage or threat problems caused by predators as provided by state law and regulation (Section 2.4.4.1), but they may not have the necessary effective equipment or proficiency in its humane, safe, and effective use compared to that available from WS-New Mexico and commercial WCOs.

3.4.2 How do PDM activities conducted by all entities, including WS-New Mexico, complement and compare?

- As discussed in Section 3.9, proficiency and experience of the person using lethal and non-lethal take methods are critical for ensuring effectiveness, selectivity, and humaneness. Commercial WCOs are issued permits by NMDGF and are proficient in their methods and activities, but few companies have the capability and/or interest to respond to requests for depredating bear, cougar, or some other species in this EA. WCOs not currently covering these species may not be equipped, prepared, or experienced to address conflicts with those species.

- Individual landowners may also hire or request other individuals who are not permitted WCOs to address damage problems, or address the problems themselves. Individual landowners are less likely to have the proficiency, experience, or skill for using traps, snares, harassment equipment, or firearms for lethal take of predators in a humane, selective, and/or effective manner. Landowners and their agents may use traps, snares, and firearms in a manner inconsistent with best practice standards for humaneness and effectiveness. They would also not be required to use the same decision process that WS-New Mexico uses (APHIS-WS Decision Model; Section 2.3.1.2).

3.4.2.1 Small predators

Many commercial WCOs with the capabilities to address predator damage or risk situations focus on small predators such as raccoons and skunks. WS-New Mexico average take of these species is generally low compared to those taken by WCOs locally (Table 3.1).

3.4.2.2 Bear and cougar

Individuals who request assistance from NMDGF for bear and cougar conflicts may get direct assistance from the agency. NMDGF may refer the request to an NMDGF agent such as WS-New Mexico, or the landowner may designate their own agent or they may take the bear or cougar themselves. The average take of bears and cougars reported to NMDGF far exceeds the number taken by WS-New Mexico (Table 3.1). Therefore, if WS-New Mexico was not available to provide for lethal take of depredating or threatening bear or cougar, NMDGF would have to increase their responses and landowners might begin to take lethal action themselves or authorize others as their agents.

3.4.2.3 Coyotes

Coyotes taken under NMDGF permit for aerial operations and aerial recreational take is more than one and a half times number of coyotes taken by WS-New Mexico in response to requests for PDM (Table 3.1). Aerial operators under permit from NMDGF are hired and paid for by livestock producers or others (as are WS-New Mexico aerial operations), and are restricted to flying only under the purpose, location, and term of the permit. Landowners can take coyotes themselves or have someone else designated as their agent remove them. Coyotes are classified as unprotected furbearers in New Mexico and their take is not required to be reported.

In the state of New Mexico, M-44 devices (sodium cyanide) and Livestock Protection Collars (sodium fluoroacetate) can only be used by WS-New Mexico and private applicators certified by the New Mexico Department of Agriculture, per the EPA label. M-44 devices account for approximately 22.19% of total WS-New Mexico annual coyote take (average 688.6 coyotes per year) from WS FY 2015 through FY 2019 (Table 2.1, Table E.1). Livestock Protection Collars account for 0.05% of the total WS-New Mexico annual coyote take (average less than 2 coyote per year) from WS FY 2015 through FY 2019. WS-New Mexico conducts approximately 58.8%

of its coyote operations on private land (Table 2.2). If WS-New Mexico is restricted in its ability to take coyotes lethally under alternatives 2 through 5, it is assumed that producers would request more NMDGF permits for aerial operations, commercial operators would have to expand their capabilities and areas of operation, and/or landowners would begin to or increase their lethal take actions themselves or by requesting assistance from other individuals.

Table 3.1. Average annual known predator take in New Mexico by source, FY 2015- FY 2019[1].

Species[1]	WCO take[2]	Aerial shooting take (non-WS)[3]	Other damage take[4]	Recreational take[5]	Total WS take[6]
Coyote	0	405	0	5,773	4,480
Black bear	0	0	86	460	2
Striped Skunk	0	0	0	430	522
Hog Nosed Skunk	0	0	0	30	<1
Raccoon	19	0	49	353	3.4
Cougar	0	0	54		6
Gray Fox	0	0	7	1,977	16
Kit Fox	0	0	7	134	5.4
Swift Fox	0	0	7	42	7.4
Red Fox	0	0	7	141	<1
Badger	0	0	0	172	9.6
Bobcat	0	0	4	1,662	16

[1] For details see Section 3.5; Tables 3.3 through 3.16. Feral/free-ranging dogs and cats are managed by local authorities and their take cannot be estimated.
[2]Wildlife Control Operators are not permitted to conduct lethal control for most predator species in NM.
[3] Airborne hunting permits are granted by NMDGF to private operators for coyote and feral swine aerial shooting to protect livestock, domesticated animals, or natural resources (NMDGF 2017).
[4] Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2016).
[5] Represents the number of predators taken during reported recreational harvest (hunting and trapping take regulated by NMDGF) and not related to predators removed for damage management. NMDGF has not tracked coyote or skunk harvest since 2014. The number provided for coyotes and skunks represents a three year average (2012, 2013, and 2014).
[6] Intentional and unintentional WS-New Mexico take (MIS 2018).

3.4.2.4 Summary

Although there are several types of entities conducting PDM in New Mexico (NMDGF, WCO, WS-New Mexico, permitted individuals, private individuals), those that are currently doing so have evolved over time and often complement one another. There is overlap for some of the species and or situations, and there are some areas of expertise and skill sets that overlap as well. However, there are differences to where and or when these different entities are or would be involved in conducting PDM. Because there is a difference in the level of efficiency and effectiveness, especially with private individuals, and uncertainty in WCO's readiness to conduct some of these activities, it would be hard to know what the outcome would be in the absence of one or the other. It is possible that given the absence of one or more entities, the others would be able to fill in. It is also possible, that given the limitations discussed, that groups would not be able to fill in behind one or more of the others.

3.4.3 Benefits of the WS-New Mexico program

WS-New Mexico employees are highly trained professionals that adhere to a myriad of measures, such as APHIS-WS Directives (Section 2.4) that are designed to minimize adverse effects on the environment and reduce risks to humans. WS-New Mexico records its activities through the MIS database so that information can be readily available for environmental analysis, partner agency use, and for public scrutiny. For example, all APHIS-WS lethal and non-lethal intentional and unintentional take of all species, regardless of their status, is presented in program data reports for each state and summarized nationally (https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/SA_Reports/sa_pdrs). WS-New Mexico's use of the APHIS-WS Decision Model helps to ensures that PDM is performed according to all applicable federal, state, and local laws and agency policies in the most effective, selective, and humane way possible (Section 1.10.3, Section 2.4).

As a federal agency responsible for compliance with NEPA, APHIS-WS documents and analyzes its activities and involves other agencies, Tribes, and the public to ensure that it makes informed and transparent decisions about PDM. It is under the umbrella of NEPA that all of APHIS-WS's PDM activities are reviewed for their effects on the human environment. The effects of PDM methods on humans and the environment, results of ESA Section 7 consultations, and Tribal government concerns are among the physical, biological, and sociocultural issues included in a NEPA document. The State of New Mexico does not have a state NEPA-equivalent law, so public participation in PDM decision-making based on evaluation of issues and comparisons of alternatives does not occur.

Effects of private actions are not generally reportable to the public unless the action is taken under a permit or is required to be reported by state law. Because of the federal NEPA process requiring the agency to evaluate its activities on the human environment, and because APHIS-WS policy is to allow the public to comment on EAs before decisions are made, special interest groups and interested citizens are able to focus their attention on federal agency decision-making where it would be more difficult or even at times not possible to discover the actions, assess and understand the effects, and participate in decision-making of other entities.

3.5 IMPACTS ON TARGET SPECIES

This section includes the direct and cumulative analyses of potential impacts of WS-New Mexico PDM on populations of individual predator species in New Mexico. These analyses include all intentional take (direct lethal removal) by WS-New Mexico, and all other take reported to state management agencies including hunter and trapper harvest and some take by private citizens for depredation or health and safety reasons.

3.5.1 What methodologies and assumptions were used for population analysis?

Estimating wildlife populations over large areas can be extremely difficult, labor intensive, and expensive. State and federal wildlife management agencies have limited resources to conduct wildlife population surveys and monitor trends.

States may monitor the status of wildlife populations by assessing sex ratios and age distribution. Indices of relative abundance or data on catch-per-unit effort from hunter surveys also serve as relative measures of population size and status. This EA uses the best available information from jurisdictional agencies and peer-reviewed literature to provide estimates of wildlife population size and status.

The magnitude of the potential impacts on target species is quantified to the greatest extent possible for each of the alternatives considered, based upon population estimates from the literature and available NMDGF data. Tables 3.3 through 3.16 provide an overview of the status of the statewide populations and estimated populations for the predator species included in this EA. Population demographic information is included in the description for each species, and information on sources of mortality for each species is provided in the tables incorporated into the analysis for each species (Tables 3.3 through 3.16).

NMDGF estimates populations of bears, cougars, and protected furbearers. However, for the other predator species in this EA, NMDGF does not estimate abundance. In order to estimate population size for these species, conservative estimates are derived from the best available density estimates reported in the literature, with preference given to publications and studies in New Mexico or states having similar habitat. The lowest estimate is assumed to be the minimum population, and is further validated through NMDGF review. Habitat suitability indices, localized density fluctuations, and immigration/emigration are not factored into these calculations, nor is density in New Mexico based on quantity of habitat, as none of this information is available. All population estimates are considered conservative, as we have used the lowest population estimate among the ranges of those available in the literature.

New Mexico has a land area of 77.8 million acres. WS-New Mexico (as of 6/25/2018) has access, including public lands to 75,255 square miles to conduct PDM, approximately 62% of the state's total area. Approximately 39% of WS-New Mexico's PDM occurs on private land (or 13% of the state's total land acreage). The land area under agreement is provided to show the proportional breadth of area in which WS-New Mexico may work compared to the total range of predators in the state.

Furthermore, WS-New Mexico actively works on only a small number of the properties under cooperative service agreements or federal annual work plans at any given time. Of those properties being actively worked, PDM activities are conducted on only a fraction of the property. For instance, WS-New Mexico may conduct PDM activities, including setting equipment, in a small "footprint" of the total property's area and for a limited duration. Therefore, totaling the acreage of all the areas WS-New Mexico has the potential to work is an overestimation when assessing the magnitude of impacts on statewide predator populations.

In order to analyze the level of effects of WS-New Mexico on the individual species' populations, available take data is presented annually by species for FY 2015 through FY 2019 (Tables 3.2

through 3.16). WS-New Mexico's intentional take is used to analyze the direct effects on species populations.

All sources of WS-New Mexico take of predator species are combined with all known sources of non-WS take in New Mexico to represent the cumulative take for FY 2015 through 2019. Cumulative take may include measures of:

- WS-New Mexico intentional take of a predator species;
- WS-New Mexico unintentional take of a predator species;
- NMDGF removal (intentional lethal removal conducted by NMDGF or its agent);
- Recreational take regulated by NMDGF;
- Private Wildlife Control Operators (WCOs) take (reported to NMDGF);
- Other allowable take for damage or threats to human health or safety reported to NMDGF;
- Other known mortality sources, such as vehicle collisions or poaching.

To assess whether cumulative take is negatively affecting a predator's population, cumulative take is compared to the maximum sustainable harvest- the amount of human-caused mortality from all known sources that can be sustained (Maunder 2008). In this case, the proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019 is compared to the lowest maximum sustainable harvest level from the literature. Since the cumulative take is compared to the conservative statewide population estimate for each species, the cumulative impact analyses in this section adjust for imperfect data and err in favor of overestimating potential impacts on predator populations.

Additionally, similar calculations are made to determine the projected cumulative impacts under the projected WS annual maximum anticipated take scenario. The WS annual maximum anticipated take is represented as the most WS-New Mexico could take in a given year under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D). The projected annual cumulative take provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum anticipated take scenario. The proportion is then compared to the lowest maximum sustainable harvest level from the literature.

Under no circumstances should the projected WS annual maximum anticipated take be interpreted as the target number of animals WS-New Mexico seeks to remove.

As explained in detail in Chapters 1 and 2, APHIS-WS personnel work to resolve conflicts with wildlife and facilitating human-predator coexistence while minimizing risk of adverse impacts on a case-by-case basis. Furthermore, APHIS-WS policy gives preference to non-lethal methods where practical and effective (WS Directive 2.101, Section 2.4.1.1).

Cumulative impacts rely on data that can be collected. Unknown and unreported mortality can't be calculated, however WS-New Mexico has used maximum anticipated take projections and conservative population estimates to consider potential impacts. These analyses do not incorporate take from PDM activities conducted in adjacent states. Wildlife management authority resides with the states. WS-New Mexico's analysis is on assisting the State of New Mexico and other entities that are within New Mexico in accordance with New Mexico statues and laws. The information compiled in the analysis of this EA is sufficient to address the impacts associated with the alternatives for WS-New Mexico involvement in PDM in New Mexico.

3.5.2 What is the relationship of climate change to predator population dynamics?

The Intergovernmental Panel for Climate Change - Summary for Policymakers (IPCC 2014) reports historic warming of 0.85°C during 1880 to 2012, and predicted surface temperature increases of 0.3°C-0.7°C during 2016–2035 with associated ecological impacts. WS-New Mexico considers the best available information when assessing program impacts on the environment, thus new information about climate effects on vulnerable resources would be considered appropriately. WS-New Mexico sought to consider predicted climate effects on the environment from two perspectives: the potential for climate change to affect PDM program needs, and the potential for cumulative impacts on wildlife and other issues evaluated in this EA.

WS-New Mexico considered predicted climate change effects on coyotes (*Canis latrans*), black bears (*Ursus americanus*), cougars (*Puma concolor*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), badgers (*Taxidea taxus*), bobcats (*Lynx rufus*), and red (*Vulpes vulpes*) and grey (*Urocyon cinereoargenteus*) foxes. Studies found through literature searches related to climate change effects on these species focused primarily on polar bears (*U. maritimus*) which specialize in hunting from sea ice and are therefore especially vulnerable (Derocher 2004, Regehr et al. 2007, Atwood et al. 2016). Arctic foxes (*Alopex lagopus*), that share in risks related to sea-ice loss, have been studied somewhat less extensively for these effects (Kim et al. 2014).

No significant body of peer-reviewed science on predicted climate change effects on predator species targeted or taken unintentionally by WS-New Mexico appears to exist at this time. Although publications were relatively few, the most frequent results were for red and grey foxes. For example, Teacher et al. (2011) studied historic red fox distribution in Europe relative to climate and concluded that future climate change may not seriously impact their distribution. Mcalpine et al. (2008) documented the first known instance of grey fox occurrence in New Brunswick, Canada, suggesting possible climate-mediated range expansion as the reason for this occurrence. In addition, concerns have been raised that since red foxes are competent reservoirs for arctic fox variant rabies, increasing temperatures could result in changes to red and arctic fox population dynamics with consequential changes in the occurrence of fox rabies (Kim et al. 2014). While irruptions of fox rabies in red foxes have occurred historically at lower latitudes, impacts to PDM in New Mexico would likely be low to non-existent given relatively recent successes at control (MacInnes et al. 2001, Rosatte et al. 2007, Slate et al. 2014). Rabies in grey foxes is likewise under control (Sidwa et al. 2005). Finally, Mugaas et al. (1993) studied the distribution of raccoons and related species and suggests a high level of climate adaption by raccoons as an explanation for their wide distribution and success.

Evidence for effects from global climate change from or to current or proposed PDM activities in New Mexico is lacking. Consequently, WS-New Mexico expects no climate-related impacts to or from its proposed activities. WS-New Mexico remains committed to monitoring program effects on target species and on other environmental resources, in coordination with the appropriate resource management agencies. Finally, by keeping ESA Section 7 consultations with the

USFWS up-to-date (Section 3.6), WS-New Mexico ensures that its PDM activities would not jeopardize even the most vulnerable species.

3.5.3 What are the direct and cumulative impacts on coyote populations?

3.5.3.1 Coyote life history information

The coyote resembles a medium-sized dog, with adults weighing an average of 22 to 30 pounds. Coyotes were once found primarily in the prairies and deserts of Mexico and central United States, but have expanded their range to include much of North America since the 1700s. Coyotes are widely distributed and common in New Mexico. In the wild, they typically feed on small mammals, birds, reptiles, fruits, seeds, and carrion. In urban and suburban areas, they also feed on rabbits and pets, including cats. Coyotes can also feed on larger mammals, such as deer, antelope, and livestock, and scavenge when opportunity arises.

Coyotes have strong ability to adapt to a wide variety of conditions, including those created by humans and their resource-rich subsidized environments. Coyotes are highly mobile animals with home ranges that may vary seasonally and with the sex and age of the animal (Pyrah 1984, Servin and Huxley 1995, Gese 2001). Alpha pairs have stable territories that they defend (Gese 1998, Wallach et al. 2009), while single transient coyotes may travel long distances until they become established within a territory. They normally hunt during the evening and night (except for those habituated to human presence), singly or in pairs, but in late summer or early fall may hunt with the family group (Section 1.12.3.2).

Coyotes annually produce one litter of four to eight pups in April and May (Knowlton 1999). The young disperse at about six to nine months (Bekoff 1980). Only the alpha pair breed and only 10% of the young from a given pair need to survive and reproduce to replace the pair. The remaining 90% of any subdominant animals may either stay with the breeding pair to assist with raising pups or, more likely disperse and often die before establishment in a new territory (Knowlton et al. 1999).

Coyote spatial organization is complex and can vary between study sites and with seasonal breeding activities (Messier and Barrette 1982, Windberg and Knowlton 1988). Each occupied coyote territory may have several non-breeding helpers at the den during whelping (Bekoff and Wells 1982, Allen et al. 1987). Messier and Barrette (1982) reported that from November through April, 35% of the coyotes were in groups of three to five animals and Gese et al. (1998) reported that coyote groups of two, three, four, and five comprised 40%, 37%, 10% and 6% of the resident population, respectively. The presence of unusual food concentrations and nonbreeding helpers at the den can influence coyote densities and complicate any effort to estimate abundance (Danner and Smith 1980). To that end, a positive relationship was established between coyote densities in mid-late winter and the availability of livestock carcasses (Roy and Dorrance 1985).

3.5.3.2 Coyote population information

Coyotes are found throughout the continental United States (Gese and Terletzky 2009), including throughout the entire State of New Mexico and its urban areas. The coyote's ability to adapt to changing environmental conditions and its opportunistic nature has resulted in its increased abundance and wider distribution during the past several decades (Mastro 2011). Habitat changes caused by human land use and development that have occurred over the last two hundred years often favor this species.

Coyotes are classified as unprotected furbearers in New Mexico and there is no closed season or bag limit. Due to this statutory classification, NMDGF does not track or attempt to estimate coyote population levels or densities, and has minimal information on harvest levels. However, NMDGF indicates that coyote populations in New Mexico are stable (Stewart Liley, NMDGF, pers. comm. 08/15/2018).

Coyote population densities vary depending on the time of year, food abundance, and habitat. Many authors have estimated coyote populations throughout the west and elsewhere (e.g., Knowlton 1972, USFWS 1979, Pyrah 1984, Camenzind 1978, Voigt and Berg 1999, Gese and Terletzky 2009, Hurley et al. 2011), reporting densities that ranged from 0.39/mi^2 in Montana pre-whelping to a high of 3.55/mi^2 in Wyoming post-whelping. Coyote densities as high as 5/mi2 have been reported in the Southwest (Voigt and Berg 1999). Knowlton (1972) estimated coyote densities westwide to be an average of 0.5 to 1.0/mi^2 over a large portion of the coyote's range. A conservative estimate of the coyote population for New Mexico, based on what we believe to be a conservative assumption of 1.0 coyote/mi^2, is 120,000 pre-whelping. The post-whelping population would be about 320,000 if ⅔ bred and pairs had an average litter of 5 pups.

In a study by Gese (2005), approximately 44% to 61% and 51% to 75% of an estimated coyote population was removed from a 131 mi^2 project area using aerial shooting and trapping, respectively. Removals resulted in substantial reductions in coyote pack size and an associated decrease in density, but both pack size and density rebounded to pre-removal levels within eight months. Radio collar data and shifts in age structure support the hypothesis that the coyotes colonizing the area after control were non-territorial individuals, which included yearlings from adjacent denning pairs of coyotes. Mean litter size did not differ substantially after the first year of winter and spring coyote removals, but increased the second year. Average litter size was correlated to the density of coyotes entering the breeding season (Gese 2005).

Coyote populations with strong social structure can be resilient in the face of moderate levels of exploitation (Ray et al. 2005, Ripple et al. 2013). Pitt et al. (2001) and Pitt et al. (2003) assessed the impact of removing a set proportion of a coyote population during one year and then allowing the population to recover. All populations recovered within one year when <60% of the population was removed. Recovery occurred within five years when 60%-90% of the population was removed. Pitt et al. (2001) and Pitt et al. 2003 also evaluated the impact of removing a set proportion of the population every year for 50 years. When the removal rate was <60% of the population, the population size was the same as for an unexploited population. These findings are consistent with an earlier model developed by Connolly and Longhurst (1975) and revisited by Connolly (1995), which indicated that coyote populations could withstand an annual removal of up to 70% of their numbers and still maintain a viable population.

3.5.3.3 Coyote population impact analysis

3.5.3.3.1 WS-New Mexico direct effects on coyotes

The greatest number of requests for assistance with PDM made to WS-New Mexico were related to coyotes. In response, WS-New Mexico has intentionally taken an average of 3,103 coyotes per year statewide during FY 2015 – FY 2019, including individual coyotes and their dens; Table 3.2). WS-New Mexico unintentionally removed 1 coyote during the analysis period.

Included in the reported intentional take numbers is the take of coyotes in dens, estimated at approximately four individuals per den. This estimate is based on average den occupancy, with a 50% likelihood of dens conservatively containing one adult with six pups per litter (Pyrah 1984, Gese et al. 1989, Wapenaar et al. 2012), for a total of seven coyotes. The other 50% of the time, an estimate of one coyote per den is used to account for scenarios where there is one lone adult, a den with less than six pups due to juvenile mortality or dispersal after maturation, and vacant dens.

Almost 21% of the coyotes were taken from aerial shooting, approximately 23% are taken by traps and snares, 29% were taken by ground shooting and calling and shooting, 26.7% were taken by M-44s (sodium cyanide), and less than 0.1% were taken by use of sodium nitrate gas cartridges in dens (Table 2.1, Table E.1). Most coyotes are taken by WS-New Mexico on private land (Table 2.2) for livestock protection.

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future coyote removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS-New Mexico annual maximum take would be 7,010 coyotes (Appendix D).

3.5.3.3.2 Cumulative mortality on New Mexico's coyote population

Coyotes may be taken legally at any time on public or private land. However, it is reasonable to assume that much of the private take of coyotes not associated with damage occurs in the winter period when furs are prime and have monetary value. Coyote harvest reporting is voluntary in New Mexico, and reporting was not available from 2015 – 2021. The last recorded numbers showed an annual average take of 5,773 coyotes, however there is no way of knowing what percentage of the public participated in reporting during that time. This number is a conservative estimate used for our calculations (Table 3.2).

The largest cumulative take was 9,707 coyotes in 2017, approximately 8.1% of the total estimated population. WS-New Mexico's portion of the cumulative take was 2.9%, relative to the annual maximum sustainable harvest of 60% (Table 3.2). If WS-New Mexico were to take the annual maximum take of 7,010 coyotes, the projected cumulative take would be approximately 11.24% of the population, with WS-New Mexico contributing 52% of the cumulative amount.

3.5.3.4 Conclusion: Coyote

Given the stable population trend for coyotes in the state, the low unintentional take, and an annual maximum sustainable harvest level of 60%, cumulative impacts on the coyote population from all causes, including take by WS-New Mexico, is not adversely impacting the size or sustainability of the coyote population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded coyote mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, is not adversely impacting the size or sustainability of the New Mexico coyote population.

Should an increase in requests for assistance with coyote damage result in the projected annual WS maximum take, cumulative impacts on the statewide coyote population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely affect the New Mexico coyote population.

Table 3.2. Population impact analysis of coyote take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional coyote take[1]	3,423	3,407	3,227	2,650	2,808	3,103	3,423
Estimated WS intentional den take[1,2]	0	1	3	1	2	1.4	12
WS unintentional take[1]	0	0	1	0	0	0.2	1
Recreational take[3]	5,773	5,773	5,773	5,773	5,773	N/A	N/A
Aerial Take, NMDGF Permit	405*	157	704	425	334	405	704
Total WS take	3,423	3,408	3,231	2,651	2,810	3,104	3,423
Cumulative take	9,601	9,338	9,707	8,849	8,917	9,283	9,707
Statewide population estimate[5]:							120,000 coyotes
Annual maximum sustainable harvest[6]:							60% (72,000 coyotes)
Current total WS take as a % of the population[7]:							2.85 % (3,423 coyotes)
Current cumulative take as % of population[8]:							8.1% (9,707 coyotes)
Projected WS annual maximum take[9]:							7,010 coyotes
Projected total WS take as a % of the population[10]:							5.8% (7,010 coyotes)

Projected annual cumulative take as a % of the population[11]:	11.24% (13,487coyotes)

[1] (MIS 2020).

[2] See section 3.5.3.3.1 WS-New Mexico Direct Effects on Coyotes. The estimated number of animals taken, based on the number of dens removed by WS-New Mexico (MIS 2020).

[3]. The number provided represents the estimated average number of reported animals taken during recreational harvest seasons. The figure is calculated from the last 3 years of data that was voluntarily reported to NMDGF (NMDGF 2016).

[4] Airborne hunting permits are granted by NMDGF to private operators for coyote and feral swine aerial shooting to protect livestock, domesticated animals, or natural resources.

[5]. See Section 3.5.3.2 Coyote Population Information. All estimates are rounded up.

[6] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[7] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[8] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[9]Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[10] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.
*2015 numbers not provided by NMDGF, used average for FY16-19 to compile totals

3.5.4 What are the direct and cumulative impacts on black bear populations?

3.5.4.1 Black bear life history information

Black bears are distributed throughout much of the U.S., Canada, and Mexico. Black bear populations are stable or increasing across most of their range, with an estimated 750,000 to 918,000 black bears in North America (Hristienko and McDonald 2007, Herrero et al. 2011). Black bear generally prefer forested areas and, in New Mexico, still occupy most of their original range.

Black bears are usually sexually mature at 3.5 years of age, but some females may not breed until 4.5 years (Graber 1981, Kohn 1982). Mating generally occurs in June and July, egg implantation is delayed until late November to early December, and gestation is generally 60 to 70 days (Foresman and Daniel 1983, Tsubota et al. 1987, Eiler et al. 1989, Hellgren et al. 1990). Litter size ranges from one to four; in comparison to black bears in the eastern U.S., black bears in the western U.S. generally have a smaller litters and a later mean first age to reproduction (Kasworm and Thier 1994). Lactating females usually do not breed, which explains alternate year pregnancies (LeCount 1983, Hellgren et al. 1990). Cubs stay with the females 16 to 18 months after birth, typically leaving in late spring prior to the breeding season.

Black bears are relatively long-lived, occasionally reaching 20 years of age or more in the wild (Keay 1995). As with most species, survival estimates vary by sex, age, in space and time, and to some degree by estimation method. Juvenile black bear annual mortality ranges between 20% and 70%, with orphaned cubs having the highest mortality (Kolenosky and Strathearn 1987). Natural mortality in adult black bears is approximately 10% to 20% per year (Fraser et al. 1982), but can be as high as 42% (LeCount 1987, Elowe and Dodge 1989).

There are few natural predators of adult black bears, but young bears may be killed by cougars, bobcats, and coyotes, or by other adult black bears (Larivière 2001).

Black bears are omnivores and eat a wide variety of plants and animals, including insects. Diets of black bears change seasonally and are based on food availability (Kolenosky and Strathearn 1987). Depending on availability, foods such as berries, acorns, skunk cabbage, and other herbaceous plants are very important for bears to store fat prior to hibernation. When available, bears will catch and consume deer fawns and elk calves, and feed on carrion (Bull and Heater 2001, Larivière 2001). Invertebrates also provide a consistent source of protein for bears throughout the year (Bull and Heater 2001). In areas near human dwellings, bears may be attracted to garbage, bird feeders, gardens, orchards, livestock and livestock feeds, and beehives as food sources. Some bears will also feed on the cambium of trees (Section 1.11.3).

3.5.4.2 Black bear population information

Black bear are protected as a big game animal in New Mexico (NMAC 19.31.11) with regulated hunting seasons. Landowners, lessees or their regular employees do not need a license to kill a bear that has killed domestic livestock or presents an immediate threat to human life or property. Any person taking such action must report the incident to NMDGF within 24 hours. Pelts, claws and other parts of depredating animals taken under this provision are the property of the State of New Mexico and must be delivered to NMDGF.

Based on current harvest levels, NMDGF harvest data suggest that black bear populations in New Mexico are stable (Table 3.3). NMDGF utilizes several methods to monitor black bear populations in New Mexico, including sex-age characteristics of harvested bears, and data from bear damage management activities. NMDGF manages black bears with fall hunting seasons.

NMDGF uses commonly accepted methods to monitor black bear populations in New Mexico, including sex-age characteristics of harvested bears, data from bear damage management activities, and other mortality, such as road kills, to determine impact on the black bear population. Thus NMDGF is able to monitor take from all sources and maintain a viable population in accordance with management objectives.

New Mexico is divided into 14 Bear Management Units, enabling NMDGF to better manage regional bear populations with each unit having two harvest limits: 1) the total number of bears that may be harvested, and 2) the number of female bears that may be harvested. Bear Management Units close when harvests reach 90% of the sustainable total limit, or 90% of the sustainable female limit, or when the season has ended - whichever occurs first. This procedure helps maintain healthy bear populations and avoid exceeding sustainable bear harvests. Hunters must present the hide for pelt tagging within 5 days of the kill; landowners, lessees, or their agents must notify NMDGF within 24 hours of a bear killed for actual or the threat of depredation.

There is an estimated 54,793 km^2 of primary bear habitat in the State with the population point estimate for New Mexico at 7,989 bears. The allowable harvest level cited for black bears has been estimated at 20% of the population (CDFG 2001). Mace and Chilton-Radandt (2011) reported that black bears in Montana returned to a sustainable population at a mortality rate of approximately 16% when they estimated the reproductive rate of 0.945 and a mean age of first reproduction of six years. Currently the NMDGF has set the annual bear harvest limit at 804 state-wide. This is approximately 10% of the estimated population.

3.5.4.3 Black bear population impact analysis

3.5.4.3.1 WS-New Mexico direct effects on black bear

Black bears are not a frequently taken predator species by WS-New Mexico (Tables 3.3 through 3.16). In response to requests for assistance with black bear damage, WS-New Mexico intentionally removed an average of 1.4 bears each year (Table 3.3). The year with the highest WS-New Mexico intentional take during this timeframe was FY 2017, with 3 black bears taken.

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future bear removals for PDM will be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS-New Mexico annual maximum take would be 25 black bears (Appendix D).

3.5.4.3.2 Cumulative mortality

Various sources of black bear removals contribute to the cumulative take of bears in New Mexico (Table 3.3).

Recreationalists removed an average of 460 black bears per year (or about 5.7% of the total estimated population). An average of 56 black bears were taken per year during FY 2015 through 2019 for damage to livestock, agriculture, and property by sources other than WS-New Mexico, including bears removed for human health and safety concerns. . Other known types of mortality reported to NMDGF include roadkill and illegal kills, an average of 29 bears per year (Table 3.3).

Non-WS-New Mexico take is approximately 7.6% of the total estimated black bear population in New Mexico. Average annual cumulative take of black bears from all known sources is 611 bears per year, representing a close estimate of total take given bear take reporting requirements. The largest cumulative take was 788 bears in FY 2013, approximately 10% of the population, with WS-New Mexico contributing 0.5% of the cumulative amount. (Table 3.3, Table 3.16). If WS-New Mexico were to take the projected annual maximum take of 25 bears, the cumulative take would be approximately 10.13% of the population, with WS-New Mexico contributing 0.31% to the cumulative amount.

3.5.4.4 Conclusion: Black bear

Given the stable population trend for black bears in the state, the low unintentional take, and an annual maximum sustainable harvest level of 20%, cumulative impacts on the black bear population from all causes, including take by WS-New Mexico, is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded black bear mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, is not adversely impacting the size or sustainability of the New Mexico black bear population.

Should an increase in requests for assistance with black bear damage result in the projected annual WS maximum take, cumulative impacts on the statewide black bear population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely impact the size or sustainability of the black bear population.

Table 3.3. Population impact analysis of black bear take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	0	2	3	1	1	1.4	3
WS unintentional take[1]	0	0	0	0	0	0	0
Depredation take[2]	34	50	85	68	40	57	85
Recreational take[3]	413	438	485	496	469	460	496
Other sources of take[5]	20	13	54	36	21	40	64
Total WS take	0	2	3	1	1	1.4	3
Total non-WS take	467	501	624	600	530	544	624
Cumulative take	467	503	627	601	531	546	627
Statewide population estimate[6]:							7,989
Current total WS take as a % of the population[7]:							0.08% (6)
Current cumulative take as a % of the population[8]:							7.8% (627)
Projected WS annual maximum take[9]:							20
Projected total WS take as a % of the population[10]							0.25% (20)
Projected annual cumulative take as a % of the population[11]:							8.14% (650)

[1] (MIS 2018).

[2] Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2018).

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2018).

[4] Represents the number of animals taken as a result of threats to humans or pets (NMDGF 2018).

[5] Includes roadkill, accidental, found dead, and illegal sources of take (NMDGF 2018).

[6] See Section 3.5.4.2 Black Bear Population Information. This is a point estimate that includes only primary habitat and not secondary or edge habitat and does not include most tribal jurisdictions. The total estimated state-wide population is likely over 8,000.
[7] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.
[8] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.
[9] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).
[10] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.
[11] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.5 What are the direct and cumulative impacts on striped skunk populations?

3.5.5.1 Striped skunk life history information

The striped skunk is the most common member of the Mephitidae, with distributions throughout southern Canada, United States and northern Mexico. They are generally considered abundant throughout their range and have increased their geographical range in North America with extensive clearing of forests. They are not associated with any well-defined habitat type (Rosatte 1987), but are capable of living in a variety of environments including woodland, plains and streamside thickets, rock piles, old buildings, agricultural lands and urban areas.

The diet of striped skunks includes insects, earthworms, beehives, birds, eggs, small mammals, and carrion (Wade-Smith and Verts 1982, Vickery et al. 1992, Lavière and Messer 1997a). Striped skunks often are nocturnal (Larivière and Messier 1997b). The seasonal availability of prey species can cause seasonal changes in habitat preference for the striped skunk (Crabtree and Wolfe 1988, Crabtree et al. 1989).

The home range of striped skunks is not sharply defined over space and time, but is altered based on seasonal requirements, such as raising young, winter denning, feeding activities, and dispersal (Rosatte 1987). Home ranges reported in the literature averaged 0.85 to 1.9/mi^2 for striped skunks in rural areas (Houseknecht 1971, Storm 1972, Bjorge et al. 1981, Rosaette and Gunson 1984, Bixler and Gittleman 2000).

Striped skunks breed from late January through March (Verts 1967) and produce one litter of 2-10 young between April and June (Maser et al. 1981). Both males and females are sexually mature at 10 months (Wade-Smith and Verts 1982). Winter severity, lack of winter denning sites, disease, and human-caused mortality greatly impact striped skunk populations (Larivière and Messier 1998, Hansen et al. 2004, Gehrt 2005). Skunks primarily cause odor problems around homes, can transmit diseases, such as rabies and leptospirosis (Hass and Dragoo 2006), to humans and domestic animals, and sometimes prey on poultry and eggs.

3.5.5.2 Striped skunk population information

Striped skunks are classified as an unprotected furbearers in New Mexico and there is no closed season. Landowners or their agent (wildlife control operators (WCOs)) can also conduct striped skunk removal work on private land when striped skunk are causing damage, public health risk, or public nuisance. New Mexico Department of Game and Fish does not track take of unprotected furbearers.

Striped 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). Additionally, California Department of Fish and Game (1997) calculated striped skunk densities to be between 1.3 and 5.70/mi^2. 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 New Mexico are not available because, although managed by NMDGF, their population is not sampled. The striped skunk has the densest population of the five species of skunks in New Mexico and uses a total of approximately 116,006 mi^2 of habitat within New Mexican borders (Thompson et al. 1992). Using the midpoint of densities (multiplication-wise), a density could be 7.5/mi^2 which would result in a population estimate about 870,000. However, using the lowest density estimate would result in a population estimate of about 99,000. The annual maximum sustainable harvest for striped skunk is estimated at 60% of the population (Table 3.4; Boddicker 1980) or about 59,400 skunks in New Mexico.

3.5.5.3 Striped skunk population impact analysis

3.5.5.3.1 WS-New Mexico direct effects on striped skunks

Striped skunks have the second highest lethal take by WS-New Mexico during PDM activities (Tables 3.2 through 3.16). In response to requests for assistance with striped skunk damage, WS-New Mexico intentionally removed an average of 514 animals per year from FY 2015- FY 2019 (Table 3.4). WS-New Mexico unintentionally removed an average of 6 striped skunks per year during the analysis period.

WS-New Mexico takes striped skunks primarily in Dona Ana County in southern New Mexico. Most striped skunks are taken on private land (approximately 93%). They are primarily caught using cage traps. (Table 2.1, Table E.1).

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future striped skunk removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS-New Mexico annual maximum take would be 2,150 striped skunks (Appendix D).

3.5.5.3.2 Cumulative mortality

NMDGF stopped tracking recreational take of striped skunks in 2014, The average take over the last 3 reported years was 430 striped skunks annually, with a minimum take as low as 291, and a maximum take as high as 518

The average annual cumulative take of striped skunk is 952 per year. The largest cumulative take was 1,019 striped skunks in 2015, approximately 1.11% of the total estimated population, with WS-New Mexico contributing 0.59% of the cumulative amount, relative to the annual maximum sustainable harvest of 60% (Table 3.4). If WS-New

Mexico were to take the annual maximum take of 2,150 striped skunks, the projected cumulative take would be approximately 2.6% of the population, with WS-New Mexico contributing 2.17% to the cumulative amount.

3.5.5.4 Conclusion: Striped skunk

Given the stable population trend for striped skunk in the state, the low unintentional take, and an annual maximum sustainable harvest level of 60%, cumulative impacts on the striped skunk population from all causes, including take by WS-New Mexico, is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded striped skunk mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico striped skunk population.

Should an increase in requests for assistance with striped skunk damage result in the projected annual WS maximum take, cumulative impacts on the statewide striped skunk population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely impact the size or sustainability of the New Mexico striped skunk population.

Table 3.4. Population impact analysis of striped skunk take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-Year average	5-Year high
WS intentional take[1]	575	581	491	522	419	517	581
WS unintentional take[1]	14	7	1	1	1	4.8	12
Other damage take[2]	0	0	0	0	0	0	0
Recreational take[3]	430	430	430	430	430	430	430
Total WS take	589	588	492	523	420	522	589
Cumulative take	1,019	1,018	922	953	850	952	1,019
Statewide population estimate[4]:							99,000
Annual maximum sustainable harvest[4]:							(60%) 59,400
Current total WS take as a % of the population[5]:							0.59% (589 skunks)
Current cumulative take as a % of the population[6]:							1.11% (1,107)

Projected WS annual maximum take[7]:	2,150
Projected total WS take as a % of the population[8]:	2.17% (2,150)
Projected annual cumulative take as a % of the population[9]:	2.96% (2,930 skunks)

[1] (MIS 2020).

[2] NMDGF does not track skunk take by WCO's.

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2018). NMDGF quit tracking take for unprotected species after FY 2014. Numbers are an average of the previous three years.

[4] See Section 3.5.5.2 Striped Skunk Population Information. All estimates are rounded up.

[5] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[8] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[9] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.6 What are the direct and cumulative impacts on hog-nosed skunk populations?

3.5.6.1 Hog-nosed skunk life history information

Hog-nosed skunks occur in southern New Mexico from creosote desert to at least the pine-oak forest, and are most common in warm woodlands, grasslands, and deserts in their preferred habitat of rocky areas for denning (Rosatte 1987). Residential areas and farmlands are classified as secondary habitat (Thompson et al. 1992). Not much is known about hog-nosed skunks because few studies have been conducted on them (Rosatte 1987).

3.5.6.2 Hog-nosed skunk population information

The low density of hog-nosed, being somewhat similar in size to striped skunks, would likely provide a conservative estimate of the hog-nosed skunk population for New Mexico at 37,500.

3.5.6.3 Hog-nosed skunk population impact analysis

3.5.6.3.1 WS-New Mexico direct effects on hog-nosed skunks

WS-New Mexico did not take any hog-nosed skunks intentionally between FY's 2015 and 2019.

WS-New Mexico unintentionally removed an average of less than one hog-nosed skunk per year during the analysis period.

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future hog-nosed skunk removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS-New Mexico annual maximum take would be 6 hog-nosed skunks (Appendix D).

3.5.6.3.2 Cumulative mortality

NMDGF stopped tracking the recreational take of skunks in 2014. The calculated average over the last 3 years of reporting is used for this analysis (Table 3.4).

The average annual cumulative take of hog-nosed skunks is estimated at 30 per year. The largest cumulative take was 31 hog-nosed skunks in 2015 and 2017, approximately 0.09% of the total estimated population, with WS-New Mexico contributing 0% of the cumulative amount, relative to the annual maximum sustainable harvest of 10% (Table 3.4). If WS-New Mexico were to take the annual maximum take of 6 hog-nosed skunks, the projected cumulative take would be approximately 0.1% of the population, with WS-New Mexico contributing 0.02% to the cumulative amount.

3.5.6.4 Conclusion: Hog-nosed skunk

Table 3.5. Population impact analysis of hog-nosed skunk take in New Mexico, FY 2015-FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-Year average	5-Year high
WS intentional take[1]	0	0	0	0	0	0	0
WS unintentional take[1]	1	0	1	0	0	0.4	1
Other damage take[2]	0	0	0	0	0	0	0
Recreational take[3]	30	30	30	30	30	30	30
Total WS take	1	0	1	0	0	0.4	1
Estimated Cumulative take	31	30	31	30	30	30	31
Statewide population estimate[4]:							37,500
Annual maximum sustainable harvest[4]:							10% (3,750 skunks)
Current total WS take as a % of the population[5]:							<0.01%
Current cumulative take as a % of the population[6]:							.08% (31)
Projected WS annual maximum take[7]:							6

Projected total WS take as a % of the population[8]:	0.02%
Projected annual cumulative take as a % of the population[9]:	0.1% (40)

[1] (MIS 2020).

[2] Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2016).

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2016). NMDGF stopped tracking take for unprotected species after FY 2014. Numbers are an average of the previous three years.

[4] See Section 3.5.5.2 Hog-nosed Skunk Population Information. All estimates are rounded up.

[5] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[8] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[9] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.7 What are the direct and cumulative impacts on raccoon populations?

3.5.7.1 Raccoon life history information

Raccoons are highly adaptable and abundant throughout North America. They are typically associated with forested habitats, but are especially common in urban areas with the high diversity of habitats and abundant human food sources.

Raccoons are mostly nocturnal, but may be seen in the daytime, especially in the spring or fall. They frequently inhabit abandoned buildings, culverts, spaces under houses, and attics. Raccoons are omnivorous, and feed on carrion, garbage, birds, mammals, insects, crayfish, mussels, other invertebrates, a wide variety of grains, various fruits, other plant materials, and most or all foods prepared for human or animal consumption, including pet food (Sanderson 1987).

Raccoon population densities vary considerably, depending on food availability and habitat suitability, and populations can vary widely between seasons and years due to disease, harvest, and natural mortality (Gehrt 2003). Generally, 60% of females breed their first year, while 90% breed after their first year. Females have one litter per year in late March through May, with three to four young per litter. The young may stay with the females for the first year.

Raccoon damage problems involve predation on domestic fowl, damage to livestock feed, and human health and safety concerns, especially in and near residences.

3.5.7.2 Raccoon population information

Raccoons are classified as a protected furbearing mammal by NMDGF. A trapper license is required to take raccoons on public or private lands. Raccoons may be recreationally harvested

April1 through May15 and September 1 through March 31 with no bag limit. Under NMSA 17-5-3, NMDGF may issue permits for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock.

Raccoons generally do well in human-altered areas due to human food subsidies, and the highest reports of raccoon densities usually occur in urban/suburban areas. Typical rural densities run from 1 to 70 raccoons per square mile (Gehrt 2003). Beasley and Rhodes (2012) found raccoon densities of 3.37 to 117.07/mi^2 in northcentral Indiana forest patches. Urban densities in northeastern Illinois can range from 64.8 to 225.3/mi^2, with an average of 121.7/mi^2 (Prange et al. 2003, Gehrt 2004).

NMDGF estimates indicate there is approximately 118,000 km^2 of raccoon habitat in the state. Using a density estimate of 0.5-1.0 per km^2, the state-wide raccoon population estimate is 59,000 – 118,000. The annual estimated sustainable harvest limit set by NMDGF is 9,735-19,470.

3.5.7.3 Raccoon population impact analysis

3.5.7.3.1 WS-New Mexico direct effects on raccoons

Raccoons represent a very small portion of lethal predator species take by WS-New Mexico. In response to requests for assistance with raccoon damage, WS-New Mexico intentionally removed an average of only 1.6 raccoons per year (Table 3.5). WS-New Mexico unintentionally removed an average of less than 2 raccoons per year during the analysis period.

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future raccoon removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS-New Mexico annual maximum take would be 45 raccoons (Appendix D).

3.5.7.3.2 Cumulative mortality on raccoons

Various sources of raccoon removals contribute to the cumulative take of raccoons in New Mexico (Table 3.5). During 2015 through 2019, an annual average of 34.2 raccoons were taken by WCOs, and an average of 353 were reported taken as recreational harvest, for a total annual average of 396 raccoons.

The largest cumulative take was in 462 raccoons in FY 17 (Table 3.5). If WS-New Mexico were to take the annual maximum take of 45 raccoons, the projected cumulative take of 505 would be approximately 0.85% of the population, with WS-New Mexico contributing 0.07% to the cumulative amount.

3.5.7.4 Conclusion: Raccoon

Given the stable population trend for raccoon in the state, the low lethal take, and an annual maximum sustainable harvest level of 16.5%, cumulative impacts on the raccoon population from all causes, including take by WS-New Mexico, is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded raccoon mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico raccoon population.

Should an increase in requests for assistance with raccoon damage result in the projected annual WS maximum take, cumulative impacts on the statewide raccoon population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely impact the size or sustainability of the New Mexico raccoon population.

Table 3.6. Population impact analysis of raccoon take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	0	0	3	0	5	1.6	5
WS unintentional take[1]	0	6	1	0	1	1.6	6
WCO take[2]	14	51	43	46	17	34.2	51
Recreational take[4]	358	210	415	346	436	353	436
Total WS take	0	6	4	0	6	3	6
Total non-WS take	372	261	458	392	453	387.2	458
Cumulative take	372	267	462	392	459	390.4	462
Statewide population estimate[5]:							59,000
Annual maximum sustainable harvest[5]:							16.5% (9,735 raccoons)
Current total WS take as a % of the population[6]:							<0.01% (6 raccoons)
Current cumulative take as a % of the population[7]:							0.78% (462)
Projected WS annual maximum take[8]:							45
Projected total WS take as a % of the population[9]:							0.08% (45)
Projected annual cumulative take as a % of the population[10]:							0.85% (505)

[1] (MIS 2018).

[2]Wildlife Control Operator take monitored by NMDGF.

[4] Represents the number of animals taken during recreational harvest seasons (NMDGF 2018).

[5] See Section 3.5.6.2 Raccoon Population Information. All estimates are rounded up.
[6] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.
[7] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.
[8] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).
[9] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.
[10] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.8 What are the direct and cumulative impacts on cougar populations?

3.5.8.1 Cougar life history information

The range of cougars, the largest North American feline, covers an extensive distribution across western North America, including throughout New Mexico. However, densities vary across landscapes likely reflecting local distribution of their primary prey (deer and elk), but may also be affected by territorial behaviors. Cougars inhabit many habitat types from desert to alpine environments, indicating a wide range of adaptability.

Cougar density is related closely to prey availability and competitive social interactions for other cougars. Prey availability is directly related to prey habitat quality, which in turn directly influences cougar nutritional health and reproductive and mortality rates. Studies indicate that as available prey increases locally, so do cougar densities. As cougar population density increases, mortality rates from intra-specific fighting and cannibalism also increase, and/or cougars disperse into unoccupied or less densely occupied habitat, if available. These relationships of cougar to its prey and to other cougars are why densities do not reach levels observed in a number of other wildlife species. It is also why cougars may disperse into atypical cougar habitat and cause conflicts there (Bodenchuk and Hayes 2008). Shaw (1981) presented evidence that livestock such as sheep and calves provide a supplemental prey base that supports cougars through seasonal declines in their primary prey, in this case deer. Therefore, this allows an artificially high density to be reached in areas where cougar territories overlap with livestock production areas.

Variability in home range size between and within sexes is likely a function of social and reproductive status, habitat quantity and quality, and cougar population density. Arrangement of home ranges in relation to each other is governed by the cougar's mating system, energy requirements, and habitat quality. For females, home range size appears to be based on prey availability for raising young. Male home ranges may be driven primarily by social status and the presence and status of neighboring males (Logan and Sweanor 2000).

According to NMDGF female cougars typically breed for the first time between 18 and 30 months of age, and they typically breed every other year. Most females give birth between May and October, following a three-month gestation period. The average litter size is three kittens.

Most males recruited into a population are immigrants, and immigration may constitute as much as 50% of the recruitment into a population (Logan and Sweanor 2000). All males that established an independent territory after dispersal were not adjacent to the natal home range, while 78% of the females that established independent territories after dispersal were adjacent to or overlapped natal home ranges.

3.5.8.2 Cougar population information

Cougars inhabit many habitat types and are closely associated with deer and elk as primary prey. Cougars are distributed throughout New Mexico and cougar harvest is reported from most counties across the state. However, areas of human development and land use are generally unfavorable to cougars.

Cougars are currently managed by NMDGF as a big game animal. Based on habitat models developed by NMDGF in collaboration with researchers, the cougar population in 2010 was estimated to be between 3,123 and 4,269 independent adults, and the population is considered stable (Stewart Liley, NMDGF, pers. comm. 8/15/2018). NMDGF estimates that there are 186,972 km^2 of cougar habitat classified as excellent, good, moderate, and fair within the state.

Cougar hunting is currently regulated by setting harvest limits for the estimated population for each Cougar Zone (comprised of 1 or more Game Management Units) in which cougars can be hunted. The current cougar season runs from April 1st through March 31st annually (year-round) statewide. Harvest limits are enforced by monitoring the number of cougars reported killed in each zone as the hunting season progresses, and then closing the zones to cougar hunting when 90% of the harvest limit (or female sub-harvest limit) has been reached. Hunters must have harvested cougar pelts tagged by the department within 5 days of harvest or before leaving the state, whichever comes first.

Cougar density is influenced by prey availability and territoriality behaviors (Seidensticker et al. 1973, Hemker et al. 1984). Territoriality can be an important mortality factor (Maehr 1997, Logan and Sweanor 2001). Estimating population densities for cougars is difficult because of the animal's solitary and elusive behavior (Davidson et al. 2014). Cougar density estimates range from 0.01/mi^2 to 0.24/mi^2, with an average density estimate for the western states of 0.075/mi^2 (Johnson and Strickland 1992).

Cougar populations can sustain relatively moderate to heavy losses of adults and still maintain viable populations. Robinette et al. (1977) reported a sustained 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% to 50%)" cougar populations in their study area had the recruitment (reproduction and immigration) capability to rapidly replace annual losses.

Average estimated annual harvest rate reported during the 1987 to 2002 study by Laundré et al. (2007) was 23.7% of the estimated harvestable population with maximum annual harvest rate of 47.6%. Human-caused mortality was greater for male cougars (average = 36.6%) than for female cougars (10.8%). Based on comparisons with areas with low or no hunting, Laundré et al. (2007) concluded that mortality from hunter harvest appeared to be additive to other sources of mortality (harvest removed individuals in addition to the number that died from other causes) in male cougars. In females, hunter harvest appeared to be compensatory to other sources of mortality (harvest removed a portion of the population that would have died from other causes), particularly during the period when the population was increasing. Similarly, during the period of population decline, losses of females from natural mortality appeared to be the main cause for population decline and the low rate of hunter harvest during the first year of the decline seemed to have only a limited role. A study by Lindzey et al. (1992) in Utah found that cougar population recovery after hunting removal was slow, with hunting losses apparently additive to other mortality. In this study, resilience of cougar populations to hunting appears to depend on the rate of immigration into the population and the availability of females of breeding age recruited.

Because cougar populations are connected and readily subject to immigration, the level of annual maximum sustainable harvest used is 30% as reported by Ashman et al. (1983) and Robinette et al (1977), respectively, for sustaining a viable cougar populations, and consistent with the average annual mortality rate reported by Laundré et al. (2007). NMDGF has set the state's management objective at 749 total annual cougar mortalities and 303 female sub-limit mortalities. Ninety percent of total mortality limit and/or female sub-limit, whichever comes first, will close harvest in any zone.

3.5.8.3 Cougar population impact analysis

3.5.8.3.1 WS-New Mexico direct effects on cougars

In response to requests for assistance with cougar damage, WS-New Mexico intentionally removed an average of 3.8 cougars each year between 2015 and 2019 (Table 3.6). WS-New Mexico unintentionally removed 2 cougars during the analysis period.

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future cougar removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1, the projected WS-New Mexico annual maximum take would be 40 cougars (Appendix D).

3.5.8.3.2 Cumulative mortality

NMDGF sets annual harvest quotas in 19 cougar management zones that cover the entire state of New Mexico. These harvest quotas include take from all known human-caused mortalities, including hunting, animals taken on damage, and administrative removal. Per NMDGF policy, hunter harvest will cease when zone quotas are met, but livestock damage and health and human safety response will continue.

Hunters harvested an average of 272 cougars annually in New Mexico during 2015-2019. In addition, an average of 19 cougars were taken annually in response to depredation complaints, including for protection of human health and safety and in response to property damage, and there was an average of 20 administrative removals related to bighorn sheep protection per year. Additionally, an average of 15 cougars per year were reported to NMDGF killed by vehicle collisions, illegal shooting, accidental kills, and animals found dead (Table 3.6). As all take of cougars must be reported to NMDGF, this is assumed to be a close estimate of total non-WS-New Mexico take.
The average cumulative take of cougars in New Mexico is 329 per year. The largest cumulative take was 424 cougars per year, approximately 13.6% of the total estimated population, with WS-New Mexico contributing 0.28% of the cumulative amount, relative to the annual maximum sustainable harvest of 30% (Table 3.6). If WS-New Mexico were to take the WS annual maximum take of 40 cougars, the projected cumulative take would be approximately 14.56% of the population, with WS-New Mexico contributing 1.28% to the cumulative amount.

3.5.8.4 Conclusion: Cougar

Given the stable population trend for cougar in the state, the low unintentional take, and an annual maximum sustainable harvest level of 30%, cumulative impacts on the cougar population from all causes, including take by WS-New Mexico, is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded cougar mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico cougar population. This conclusion is consistent with NMDGF cougar population trend information (Stewart Liley, NMDGF, pers. comm., 8/15/2018) and NMDGF management goals.

Should an increase in requests for assistance with cougar result in the projected annual WS maximum take, cumulative impacts on the statewide cougar population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely impact the size or sustainability of the New Mexico cougar population.

Table 3.7. Population impact analysis of cougar take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	4	4	8	2	1	3.8	8
WS unintentional take[1]	0	0	1	0	1	<1	1
Recreational take[3]	239	244	238	358	282	272.2	358
Depredation Take	23	21	20	23	8	19	23
NMDGF administrative take[5]	12	17	19	28	26	20.4	28
Other mortality	20	18	15	13	7	14.6	20
Total WS take	4	4	9	2	2	4	9
Total non-WS take	294	290	292	422	323	324.2	422
Cumulative take	298	294	301	424	325	328.4	424
Statewide population estimate[7]:							3,123
Mortality Limit[7]:							749
Current total WS take as a % of the population[8]:							0.28% (9)
Current cumulative take as a % of the population[9]:							13.57% (424)
Projected WS annual maximum take[10]:							40

Projected total WS take as a % of the population[11]:	1.3% (40 cougars)
Projected annual cumulative take as a % of the population[12]:	14.56% (455 cougars)

[1] (MIS 2018).

[2] Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2018).

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2018).

[4] Represents the number of animals taken as a result of threats to humans, property or pets (NMDGF 2018).

[5] Represents administrative removals in cougar target areas to meet the management objectives of the NMDGF Cougar Management Plan, including Bighorn Sheep Protection (NMDGF 2020).

[6] Includes roadkill, accidental, found dead, and illegal sources of take (NMDGF 2020).

[7] See Section 3.5.7.2 Cougar Population Information. This is a point population estimate and annual mortality for management objectives set by NMDGF and may not reflect the true value for the population.

[8] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[9] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[10] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[11] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[12] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.9 What are the direct and cumulative impacts on gray fox populations?

3.5.9.1 Gray fox life history information

Gray foxes prefer scattered forest, chaparral, and rimrock-dominated landscapes, from southeastern Canada through the central United States, and south to western Venezuela. They are found throughout New Mexico.

Like those of the red foxes, gray fox diets include rodents and other small prey items. Gray foxes are very omnivorous as well and feed on fruit and berries. Gray fox kits are born in dens in April or May, staying nearby until they are about 3 months old.

3.5.9.2 Gray fox population information

The gray fox is classified as a protected furbearing mammal by NMDGF. A trapper license is required to take raccoons on public or private lands. They may be recreationally harvested November 1 through March 15 with no bag limit. Under NMSA 17-5-3, NMDGF may issue permits for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock. All trappers must submit annual harvest reports.

Gray fox densities have been difficult to ascertain because gray foxes are elusive and have large home ranges (Cypher 2003), but are considered tied to habitat productivity (Trapp and Hallberg 1975). Trapp and Hallberg (1975) synthesized several studies of gray fox densities to calculate a range of 1 to 27/mi^2 in the United States. Similarly, Fritzell and Haroldson (1982) compiled several studies to conclude a range of 3.1 to 5.4/ mi^2, depending on location, season, and method of estimation. Weston Glenn et al. (2009) reports red fox densities to be 2.51/mi^2 in South Carolina, but noted that red fox populations at this location are high-density, likely due to high-quality habitat.

For purposes of this analysis, we will use the NMDGF density estimate of 0.1 – 0.3 gray fox per km^2 throughout their range in New Mexico. According to NMDGF there are 279,342 km^2 of gray fox habitat and approximately 27,934 – 83,803 gray fox in the state. The NMDGF harvest management objective is a sustained level of no more than 20% of the estimated gray fox population statewide. The annual estimated sustainable harvest limit set by NMDGF for gray fox is 5,587 – 16,761 (Table 3.12).

3.5.9.3 Gray fox population impacts analysis

3.5.9.3.1 WS-New Mexico direct effects on gray fox

In response to requests for assistance with gray fox damage between FY 2015 and 2019, WS-New Mexico intentionally removed an average of 3 gray foxes a year. WS-New Mexico unintentionally removed an average of 13 gray foxes per year during the analysis period.

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future gray fox removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS annual maximum take would be 105 gray foxes (Appendix D).

3.5.9.3.2 Cumulative Mortality

Various sources of gray fox removal contribute to the cumulative take of gray foxes in New Mexico (Table 3.8). Take reported to NMDGF included an annual average take of 1,977 gray foxes as recreational harvest.. NMDGF also takes a number of foxes as a response to depredation complaints, but the field officers do not distinguish between which species of fox. For this reason the total depredation take for all species of foxes is incorporated into the cumulative take for gray fox as other damage take. Depredation take for FY2015-2019 averages 11 foxes annually.

The average annual cumulative take of gray fox is 1,992 per year. The largest cumulative take was 2,366 gray foxes per year, approximately 8.5% of the population, with WS-New Mexico contributing 0.8% of the cumulative amount, relative to the annual maximum sustainable harvest of 25% (Table 3.8). If WS-New Mexico were to take the annual maximum take of 105 gray foxes, the projected cumulative take would be approximately 8.5% of the total estimated population, with WS-New Mexico contributing 0.36% to the cumulative amount.

3.5.9.4 Conclusion: Gray fox

Given the stable population trend for gray fox in the state, the low unintentional take, and an annual NMDGF harvest management objective of no more than 20%, cumulative impacts on the gray fox population from all causes, WS-New Mexico is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded gray fox mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico gray fox population.

Should an increase in requests for assistance with gray fox result in the projected annual WS maximum take, cumulative impacts on the statewide gray fox population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely affect the New Mexico gray fox population.

Table 3.8. Population impact analysis of gray fox take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	1	4	4	5	1	3	5
WS unintentional take[1]	6	37	9	9	6	13.2	37
Other damage take[2]	1	11	17	18	7	10.8	18
Recreational take[3]	2,290	1,796	2,353	2,121	1,323	1,977	2,353
Total WS take	7	41	13	14	7	16	41
Cumulative take	2,298	1,848	2,383	2,153	1,337	2,004	2,383
Statewide population estimate[4]:							27,934
Annual maximum sustainable harvest[4]:							20% (5,587 gray fox)
Current total WS take as a % of the population[5]:							0.15% (41 gray fox)
Current cumulative take as a % of the population[6]:							8.5% (2,366)
Projected WS annual maximum take[7]:							105

Projected total WS take as a % of the population[8]:	0.38% (105 gray fox)
Projected annual cumulative take as a % of the population[9]:	8.7% (2,430)

[1] (MIS 2018).

[2] Represents the number of animals taken by landowners or NMDGF, as a result of damage (NMDGF 2018) or threats to human health and safety. Numbers shown represent all fox species combined.

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2016).

[4] See Section 3.5.13.2 Gray Fox Population Information. All estimates are rounded up.

[5] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[8] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[9] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.10 What are the direct and cumulative impacts on kit fox populations?

3.5.10.1 Kit fox life history information

Kit fox (*Vulpes velox macrotis*) occupy desert or grassland habitats, and occasionally the fringe of agricultural lands. This species prefers areas where the soils are loose-textured to easily dig underground dens, which are used throughout the year (O'Farrell 1999, Scott-Brown et al. 1999). Kit fox are most common in areas that support large populations of prey, such as rodents, especially kangaroo rats (*Dipodomys* spp.) and deer mice (*Peromyscus* spp.), birds, and insects. They reach reproductive maturity between 10 and 22 months of age and litters average three to five pups.

3.5.10.2 Kit fox population information

The kit fox is classified as a protected furbearing mammal by NMDGF. Kit fox are found in southwest New Mexico. NMDGF's Furbearer Population Assessment and Harvest Management Matrix have estimated the New Mexico kit fox population to range from 12,429 - 20,715 animals. They may be recreationally harvested November 1 through March 15 with no bag limit. Under NMSA 17-5-3, NMDGF may issue permits for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock. All trappers must submit annual harvest reports.

NMDGF estimates there are 103,578 km^2 of kit fox habitat in the state and the density of kit fox is 0.12 – 0.2 per km^2 throughout their range in New Mexico. The NMDGF harvest management objective is a sustained level of no more than 20% of the estimated kit fox population statewide. The annual estimated sustainable harvest limit set by NMDGF for kit fox is 2,450 – 4,143 (Table 3.9).

3.5.10.3 Kit fox population impacts analysis

3.5.10.3.1 WS-New Mexico direct effects on kit fox

WS-New Mexico did not intentionally remove any kit fox between FY's 2015 and 2019. An average of 5.4 kit fox were removed by WS-New Mexico unintentionally per year during the analysis period. WS-New Mexico expects that future gray fox removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS annual maximum take would be 30 kit foxes (Appendix D).

3.5.10.3.2 Cumulative mortality

Kit fox removal consists of various sources making up the cumulative take of in New Mexico (Table 3.9). Take reported to NMDGF included an annual average take of 133.8 kit foxes as recreational harvest. NMDGF also takes a number of foxes as a response to depredation complaints, but the field officers do not distinguish between which species of fox. For this reason the total depredation take for all species of foxes is incorporated into the cumulative take for kit fox as other damage take. Depredation take for FY2015-2019 averages 11 foxes annually.

The average annual cumulative take of kit fox is 150 per year. The largest cumulative take was 210 kit foxes in a single year, approximately 1.68% of the population, with WS-New Mexico contributing less than .01% of the cumulative amount, relative to the annual maximum sustainable harvest of 25% (Table 3.9). If WS-New Mexico were to take the annual maximum take of 30 kit foxes, the projected cumulative take would be approximately 1.9% of the total estimated population, with WS-New Mexico contributing 0.02% to the cumulative amount.

3.5.10.4 Conclusion: Kit fox

Given the stable population, the low unintentional take, and an annual NMDGF harvest management objective of no more than 20%, cumulative impacts on the kit fox population from all causes, WS-New Mexico is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded kit fox mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico gray fox population.

Should an increase in requests for assistance with kit fox result in the projected annual WS maximum take, cumulative impacts on the statewide kit fox population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely affect the New Mexico kit fox population.

Table 3.9. Population impact analysis of kit fox take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	0	0	0	0	0	0	0
WS unintentional take[1]	2	9	9	3	4	5.4	9
Other damage take[2]	1	11	17	18	7	10.8	18
Recreational take[3]	207	185	81	77	119	133.8	207
Total WS take	2	9	9	3	4	5.4	12
Total non-WS take	208	196	98	95	126	144.6	208
Cumulative take	210	205	107	98	130	150	210
Statewide population estimate[4]:							12,429
Annual maximum sustainable harvest[4]:							20% (2,486 kit fox)
Current total WS take as a % of the population[5]:							0.07% (9 kit fox)
Current cumulative take as a % of the population[6]:							1.68% (210)
Projected WS annual maximum take[7]:							30
Projected total WS take as a % of the population[8]:							0.24% (30 kit fox)
Projected annual cumulative take as a % of the population[9]:							1.93% (240)

[1] (MIS 2018).

[2] Represents the number of animals taken by landowners or NMDGF, as a result of damage (NMDGF 2018). Numbers shown represent all fox species combined.

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2018).

[4] See Section 3.5.13.2 Gray Fox Population Information. All estimates are rounded up.

[5] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[8] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[9] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.11 What are the direct and cumulative impacts on swift fox populations?

3.5.11.1 Swift fox life history information

Swift fox (*Vulpes velox velox*) live primarily in short-grass prairies and deserts. Like many canids, swift fox are omnivorous, and its diet includes grasses and fruits, as well as small mammals, carrion, and insects. In the wild, the lifespan of the swift fox is 3 to 6 years, and breeds once annually, from late December to March, depending on the geographic region. Pups are born from March to mid-May, and are weaned at 6 to 7 weeks. Swift fox are found in east central New Mexico.

3.5.11.2 Swift fox population information

The swift fox is classified as a protected furbearing mammal by NMDGF. Swift fox are found in southeast New Mexico. NMDGF's Furbearer Population Assessment and Harvest Management Matrix have estimated the New Mexico swift fox population to range from 11,106 - 18,510 animals. They may be recreationally harvested November 1 through March 15 with no bag limit. Under NMSA 17-5-3, NMDGF may issue permits for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock. All trappers must submit annual harvest reports.

NMDGF estimates there are 92,553 km^2 of swift fox habitat in the state and the density of swift fox is 0.12 – 0.2 per km^2 throughout their range in New Mexico. The NMDGF harvest management objective is a sustained level of no more than 20% of the estimated swift fox population statewide. The annual estimated sustainable harvest limit set by NMDGF for swift fox is 2,221 – 3,702 (Table 3.10).

3.5.11.2.1 WS-New Mexico direct effects on swift fox

On average New Mexico WS lethally removed 7 swift fox from FY 2015 through FY 2019, which representsless than 0.1% of the swift fox population (Table 3.10). NMDGF has set harvest management objectives of no more than 20% of the estimated swift fox population. WS expects the annual lethal removal of swift fox in New Mexico to remain similar to previous years.

Coyote removal in occupied swift fox range may positively affect swift fox (Kamler et al. 2003).

3.5.11.2.2 Cumulative mortality

Various sources of swift fox removal contribute to the cumulative take of swift foxes in New Mexico (Table 3.10). Take reported to NMDGF included an annual average take of 41 swift foxes as recreational harvest. NMDGF also takes a number of foxes as a response to depredation complaints, but the field officers do not distinguish between which species of fox. For this reason the total depredation take for all species of foxes is incorporated into the cumulative take for swift fox as other damage take.

The average annual cumulative take of swift fox is 60 per year. The largest cumulative take was 106 swift foxes per year, approximately 0.95% of the population, with WS-New Mexico contributing 0.1% of the cumulative amount, relative to the annual maximum sustainable harvest of 25% (Table 3.8). If WS-New Mexico were to take the annual maximum take of 45 gray foxes, the projected cumulative take would be approximately

1.25% of the total estimated population, with WS-New Mexico contributing 0.41% to the cumulative amount.

3.5.11.3 Conclusion: Swift fox

Table 3.10. Population impact analysis of swift fox take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	0	0	1	1	5	1.4	5
WS unintentional take[1]	9	10	4	0	7	6	10
Other damage take[2]	1	11	17	18	7	10.8	18
Recreational take[3]	96	52	39	14	8	41.8	96
Total WS take	9	10	5	1	12	7.4	12
Total non-WS take	97	63	56	33	15	52.8	97
Cumulative take	106	73	61	34	27	60.2	106
Statewide population estimate[4]:							11,106
Annual maximum sustainable harvest[4]:							20% (2,221 swift fox)
Current total WS take as a % of the population[5]:							0.11% (12 swift fox)
Current cumulative take as a % of the population[6]:							0.95% (106)
Projected WS annual maximum take[7]:							45
Projected total WS take as a % of the population[8]:							0.40% (45 swift fox)
Projected annual cumulative take as a % of the population[9]:							1.25% (139)

[1] (MIS 2018).

[2] Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2018). Numbers shown represent all fox species combined.

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2018).

[4] See Section 3.5.13.2 Gray Fox Population Information. All estimates are rounded up.

[5] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).
[8] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.
[9] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.12 What are the direct and cumulative impacts on red fox populations?

3.5.12.1 Red fox life history information

Red foxes are found throughout much of North America, Europe, Asia and North Africa, and were introduced into Australia in the nineteenth century.

They primarily hunt small rodents, insects, rabbits, ground-nesting birds, turtles, frogs, snakes, small pets, or livestock such as chickens or lambs, at night. Foxes are regarded as nuisance predators in many regions, preying on wildlife and livestock, especially poultry (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).

Fox pups are born in dens between March and May, and are weaned at eight to ten weeks. Rowlands and Parkes (1935) and Creed (1960) reported that male red foxes breed in their first year. Storm et al. (1976) stated that 95% of the females (43.6% were less than one year old) bred successfully in populations in Illinois and Iowa. Litter sizes averaged about 4.7 offspring 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 suggested that red foxes have "helpers," a phenomena observed in coyotes and other canids.

3.5.12.2 Red fox population information

The red fox is classified as a protected furbearing mammal by NMDGF. Reported red fox population densities have been as high as over 50/mi^2 where food was abundant (Harris 1977, MacDonald and Newdick 1982, Harris and Rayner 1986). Sargeant (1972) reported one den per 3 mi^2, or about 1.3 red fox/mi^2, conservatively estimating 4 fox per den. Population densities have been found to be 2.6 red fox/mi^2 in Ontario, Canada (Voigt 1987).

NMDGF estimates there are 209,302 km^2 of red fox habitat in the state and the density of red fox is 0.02 – 0.08 per km^2 throughout their range in New Mexico. NMDGF's Furbearer Population Assessment and Harvest Management Matrix estimates the New Mexico red fox population to range from 4,186 - 16,744 animals. The NMDGF harvest management objective is a sustained level of no more than 20% of the estimated red fox population statewide. The annual estimated sustainable harvest limit set by NMDGF for red fox is 4,186 – 16,744 (Table 3.12). They may be recreationally harvested November 1 through March 15 with no bag limit. Under NMSA 17-5-3, NMDGF may issue permits for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock. All trappers must submit annual harvest reports.

Red fox dispersal and immigration 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 overall population in subsequent years, but may reduce localized predation (Allen and Sargeant 1993). Phillips and Mech (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 and Mech (1970) and Voigt (1987) further stated 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 social structure and population dynamics are similar to that for coyote and red fox populations are likely to exhibit the same resilience to harvest as that modeled for coyotes above (Pitt et al. 2001), which is 70% annually.

3.5.12.3 Red fox population impact analysis

3.5.12.3.1 WS-New Mexico direct effects on red foxes

In response to requests for assistance for red fox damage between FY 2015 and 2019, WS-New Mexico did not intentionally remove any red foxes during PDM activities. In addition, WS-New Mexico unintentionally removed a total of 1 red fox during the length of the analysis period.

Based on the number of cooperative service agreements; county, state and federal budgetary constraints; and projected future requests for assistance, WS-New Mexico expects that future red fox removals for PDM will be similar to take during the past five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS-New Mexico annual maximum take would be 5 red foxes (Appendix D).

3.5.12.3.2 Cumulative mortality

Various sources of red fox removal contribute to the cumulative take in New Mexico (Table 3.11). During 2015 through 2019, recreational harvest reported to NMDGF averaged 142 red foxes taken per.

Cumulative take of red foxes from all known sources is recorded as an average of 142 per year. The largest cumulative take was 177 red foxes in FY 2019, approximately 4.2% of the total estimated population, with WS-New Mexico contributing 0% of the statewide cumulative amount, relative to the annual maximum sustainable harvest of 20% (Table 3.11). If WS-New Mexico were to take the annual maximum take of 5 red foxes, the projected cumulative take would be approximately 4.2% of the population, with WS-New Mexico contributing 0.12% to the cumulative amount.

3.5.12.4 Conclusion: Red fox

Given the stable population trend for red fox in the state, the low unintentional take, and an annual maximum sustainable harvest level of 20%, cumulative impacts on the red fox population from all causes, including take by WS-New Mexico, is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded red fox mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico red fox population.

Should an increase in requests for assistance with red fox result in the projected annual WS maximum take, cumulative impacts on the statewide red fox population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely impact the size or sustainability of the New Mexico red fox population.

Table 3.11 Population impact analysis of red fox take in New Mexico, FY 2015- 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional red fox take[1]	0	0	0	0	0	0	0
WS unintentional take[1]	0	1	0	0	0	<1	1
Other damage take[2]	1	11	17	18	7	10.8	18
Recreational take[3]	165	120	140	112	170	141.4	170
Total WS take	0	1	0	0	0	<	1
Total non-WS take	166	131	157	130	177	152.2	177
Cumulative take	166	132	157	130	177	152	177
Statewide population estimate[4]:							4,186
Annual maximum sustainable harvest[4]:							20% (837 red fox)
Current total WS take as a % of the population[5]:							0.02% (1 red fox)
Current cumulative take as a % of the population[6]:							4.2% (177)
Projected WS annual maximum take[7]:							5
Projected total WS take as a % of the population[8]:							0.12% (5 red fox)
Projected annual cumulative take as a % of the population[9]:							4.3% (183)

[1] (MIS 2018).

[2] Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2018). Numbers shown represent all fox species combined

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2018).

[4]See Section 3.5.8.2 Red Fox Population Information. All estimates are rounded up.

[5]The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6]The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7]Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[8]Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[9]Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.13 What are the direct and cumulative impacts on badger populations?

3.5.13.1 Badger life history information

Badgers are found throughout most of the western U.S. In New Mexico, badgers are most common in grasslands at lower altitudes, but they do occur in nonforested areas throughout New Mexico, including alpine meadows (Findley et al 1975). Home range sizes of adult badgers averaged 0.6 and 0.9 mi^2 for females and males in Idaho (Messick and Hornocker 1981) and ranged from 0.5 to 2.4 mi^2 in Utah (Lindzey 1978).

Badgers breed in late summer, with implantation delayed until February and the birth of one to five cubs in March or April. Family groups begin to break up in mid-summer. Females with a litter frequently remain near the den sites. Badgers are mostly nocturnal, opportunistically feeding on burrowing animals, rodents, birds, reptiles, and insects.

WS-New Mexico occasionally receives requests for assistance to resolve damages from badgers for the protection of cemeteries, rangeland, pasture, and cropland.

3.5.13.2 Badger population information

Badgers are classified as protected furbearers in New Mexico.

The lowest density estimate from the literature of 0.7 badgers/mi^2 was applied to generate a conservative statewide population estimate of 67,974 badgers. Annual maximum sustainable harvest for badger populations has been estimated at 30 to 40% (Boddicker 1980).

It has been estimated that the Curlew Valley on the Utah-Idaho border supported 1 badger/mi^2 (Lindzey 1971). Messick and Hornocker (1981) found 13/mi^2 in southwestern Idaho and noted that densities may be higher during periods when juveniles are dispersing.

A study by Hein and Andelt (1995) in Colorado estimated a minimum population density of 0.7 badgers/mi^2 by comparing scent-station visitations, spotlight surveys, headlight surveys, road mortality, and a trapping index. Clark et al. (1982) found a higher density of 4.74 badgers/mi^2 in New Mexico, Colorado, and Utah. Densities of 5 badgers/mi^2 were recorded in the National Elk Refuge in northwestern Wyoming (Lindzey 2003).

NMDGF estimates there are 285,008 km^2 of badger habitat in the state and the density of badgers is 0.08 – 0.1 per km^2 throughout their range in New Mexico. NMDGF's Furbearer Population Assessment and Harvest Management Matrix estimates the New Mexico badger population to range from 22,801 – 28,501 animals. The NMDGF harvest management objective is a sustained level of no more than 10% of the estimated badger population statewide. The annual estimated sustainable harvest limit set by NMDGF for red fox is 2,280 – 2,850 (Table 3.12). They may be recreationally harvested November 1 through March 15 with no bag limit. Under NMSA 17-5-3, NMDGF may issue permits for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock. All trappers must submit annual harvest reports.

3.5.13.3 Badger population impact analysis

3.5.13.3.1 WS-New Mexico direct effects on badgers

In response to requests for assistance with badger damage between FY 2015 and 2019, WS-New Mexico intentionally removed an average of 4 badgers each year. WS-New Mexico unintentionally removed an average of 7 badgers per year during the analysis period. Badgers are taken primarily using foothold traps, neck snares, or firearms (Table 2.1, Table E.1).

Based on cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future badger removals for PDM would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS annual maximum take would be 45 badgers (Table 3.12).

3.5.13.3.2 Cumulative mortality

Various sources of badger removals contribute to the cumulative take of badgers in New Mexico (Table 3.12). There were an average of 172 badgers per year reported to NMDGF as recreational harvest. Less than one badger per year were taken for causing damage (Table 3.12).

The average annual cumulative take of badger is 213 per year. The largest cumulative take was 282 badgers per year, approximately 0.93% of the total estimated population, with WS-New Mexico contributing 0.07% of the cumulative amount, relative to the annual maximum sustainable harvest of 10% (Table 3.12). If WS-New Mexico were to take the annual maximum take of 45 badgers, the projected cumulative take would be approximately 1.36% of the population, with WS-New Mexico contributing 0.20% to the cumulative amount.

3.5.13.4 Conclusion badgers

Given the stable population trend for badger in the state, the low unintentional take, and an annual maximum sustainable harvest level of 10%, cumulative impacts on the badger population from all causes, including take by WS-New Mexico, is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded badger mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico badger population.

Should an increase in requests for assistance with badger result in the projected annual WS maximum take, cumulative impacts on the statewide badger population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely impact the size or sustainability of the New Mexico badger population.

Table 3.12. Population impact analysis of badger take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	3	5	2	5	2	3.4	5

WS unintentional take[1]	10	10	6	3	2	6.2	10
Other damage take[2]	0	0	0	0	1	0	1
Recreational take[3]	172	267	129	106	184	172	267
Total WS take	13	15	8	8	4	9.6	15
Total non-WS take	172	267	129	106	185	171.8	267
Cumulative take	185	282	137	114	189	181.4	282
Statewide population estimate[4]**:**							22,801
Annual maximum sustainable harvest[4]**:**							10% (2,280 badgers)
Current total WS take as a % of the population[5]**:**							0.07% (15 badgers)
Current cumulative take as a % of the population[6]**:**							1.23% (282)
Projected WS annual maximum take[7]**:**							45
Projected total WS take as a % of the population[8]**:**							0.20% (45 badgers)
Projected annual cumulative take as a % of the population[9]**:**							1.36% (312)

[1](MIS 2018).

[2]Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2018).

[3]Represents the number of animals taken during recreational harvest seasons (NMDGF 2018).

[4]See Section 3.5.9.2 Badger Population Information. All estimates are rounded.

[5]The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6]The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7]Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[8]Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[9]Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.14 What are the direct and cumulative impacts on bobcat populations?

3.5.14.1 Bobcat life history information

Bobcats are found in much of the United States and southern Canada to most of Mexico, and are very abundant in the western U.S. Bobcats have become more abundant in North America than they were in 1981 (Roberts and Crimmins 2010) and are common throughout mountainous habitats in New Mexico. They are typically associated with brushy, rocky and wooded areas, and rimrock and chaparral habitat, especially where ledges occur. Prey abundance, protection from severe weather, availability of rest areas, dense cover, and freedom from disturbance are key factors(McCord 1974, Donovan et al. 2011) . Bobcats are resilient, and populations are doing well in the United States except in areas of dense human populations and extensive agriculture.

Bobcats reach reproductive maturity at 9 to 12 months and have one to six kittens in early- to mid-summer (Crowe 1975, Koehler 1987). Older male and female bobcats usually have a territory that is fairly well defined but which varies in size depending on prey density, sex, season, presence of kittens, and climate. Transient animals coexist with territorial resident animals by using less-desirable habitats. Dispersal of young bobcats generally occurs in fall or late winter. They may live up to 14 years, but annual mortality is as high as 47% (Rolley1985).

Bobcats are opportunistic and frequently prey on rabbits, rodents, beavers, and squirrels. The bobcat population health is stable throughout the United States, except in areas of high human population density and extensive agriculture.

3.5.14.2 Bobcat population information

Bobcats are classified as a protected furbearing mammal by NMDGF. They may be recreationally harvested November 1 through March 15 with no bag limit. Under NMSA 17-5-3, NMDGF may issue permits for the taking of fur-bearing animals doing damage to game, private property, poultry or livestock. All trappers must submit annual harvest reports. Anyone taking a bobcat in New Mexico must present the pelt for tagging.

Reported bobcat densities, as summarized by McCord and Cardoza (1982), have ranged from 0.1 to 7 per mi^2. Knick (1990) estimated that bobcat densities in southeastern Idaho ranged from $0.04/mi^2$ to $0.35/mi^2$, depending on jackrabbit densities. Bailey (1974) estimated bobcat densities in the same area to average about $0.14/mi^2$.

NMDGF estimates there is 181,343 km^2 of bobcat habitat in the state and estimates density at 0.2 – 0.3 km^2. The state-wide population is estimated at 36,269 – 54,403.

A bobcat population model developed by Knick (1990) based on seven 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. NMDGF has set the estimated annual sustainable harvest limit at 3,627 – 5,440 bobcats.

WS-New Mexico expects its annual lethal removal of bobcats to remain similar to previous years and does not anticipate the lethal removal of bobcats to increase substantially.

3.5.14.3 Bobcat population impact analysis

3.5.14.3.1 WS-New Mexico direct effects on bobcats

Requests for WS-New Mexico to assist with bobcats causing damage are relatively low. WS-New Mexico intentionally removed an average of 14 bobcats per year between 2015 and 2019 (Table 3.13). WS-New Mexico unintentionally removed an average of 2 bobcats per year during the analysis period.

Based on the number of cooperative service agreements, county, state and federal budgetary constraints, and projected future requests for assistance, WS-New Mexico expects that future bobcat removals for PDM in New Mexico would be similar to take during the last five years. Therefore, under Alternative 1 (current program with fluctuations in program delivery), the projected WS annual maximum take is 90 bobcats (Appendix D).

3.5.14.3.2 Cumulative mortality

Bobcat taken by various entities contributes to cumulative take in New Mexico (Table 3.9). NMDGF reports that furbearer harvest removed an average of 1,662 bobcats per year from FY 2015- FY 2019, while an average of 7.2 bobcats were taken in response to damage (Table 3.13).

The average annual cumulative take of bobcat is 1,685 per year. The highest statewide known cumulative take was 1,878 bobcats per year, approximately 5.2% of the total estimated population, with WS-New Mexico contributing less than 0.01% of the cumulative amount, relative to the annual maximum sustainable harvest of 10% (Table 3.13). If WS-New Mexico were to take the annual maximum take of 95 bobcats, the projected cumulative take would be approximately 5.3% of the population, with WS-New Mexico contributing 0.24% to the cumulative amount.

3.5.14.4 Conclusion: Bobcat

Given the stable population trend for bobcat in the state, the low unintentional take, and an annual maximum sustainable harvest level of 10%, cumulative impacts on the bobcat population from all causes, including take by WS-New Mexico, is not adversely impacting the population.

Therefore, WS-New Mexico concludes that the cumulative impact of all recorded bobcat mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico bobcat population.

Should an increase in requests for assistance with bobcat result in the projected annual WS maximum take, cumulative impacts on the statewide bobcat population would still be expected to remain low relative to the annual maximum sustainable harvest level. Given the low proportion of cumulative take, and even lower WS-New Mexico take, direct and cumulative impacts from take would not adversely impact the size or sustainability of the New Mexico bobcat population.

Table 3.13. Population impact analysis of bobcat take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	7	26	20	10	8	14.2	26
WS unintentional take[1]	2	4	0	2	1	1.8	4
Other damage take[2]	3	2	12	11	8	7.2	12
Recreational take[3]	1,649	1,661	1,817	1,855	1,328	1,662	1,855
Total WS take	9	30	20	12	9	16	30
Total non-WS take	1,652	1,663	1,829	1,866	1,336	1,669.2	1,866
Cumulative take	1,661	1,690	1,849	1,878	1,345	1,684.6	1,878
Statewide population estimate[4]:							36,269
Annual maximum sustainable harvest[4]:							10% (3,627)
Current total WS take as a % of the population[5]:							0.08%
Current cumulative take as a % of the population[6]:							5.2% (1,878)
Projected WS annual maximum take[7]:							95
Projected total WS take as a % of the population[8]:							0.26% (95 bobcats)
Projected annual cumulative take as a % of the population[9]:							5.3% (1,943bobcats)

[1] (MIS 2018).

[2] Represents the number of animals taken by landowners, NMDGF, or others as a result of damage (NMDGF 2020).

[3] Represents the number of animals taken during recreational harvest seasons (NMDGF 2020).

[4] See Section 3.5.10.2 Bobcat Population Information. All estimates are rounded up.

[5] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.

[6] The proportion of the estimated species population that could have been taken by all sources in the year with the highest take between FY 2015- FY 2019.

[7] Represents the maximum WS-New Mexico could annually take under the current program (Alternative 1) given the potential for fluctuations in program delivery (Appendix D).

[8] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by WS-New Mexico, under projected WS annual maximum take scenario.

[9] Provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.15 What are the direct and cumulative impacts on feral cat populations?

3.5.15.1 Feral cat life history information

Feral and free-ranging domestic cats are non-native and common throughout North America and New Mexico, and their wildlife prey have little defense against them. Cats are prolific breeders, having up to three litters of 4-8 kittens per year. Unlike many native predators, cats are not territorial and can exist at much higher densities than native predators. Free-roaming cats can transmit deadly diseases (Section 1.11.6) such as rabies, feline leukemia and distemper to wild cats, wildlife, and in some cases humans. The incidence of rabies in cats is higher than in any other domestic animal in the United States (Birhane et al. 2017).

Studies (Mitchell and Beck 1992, Hawkins et al. 1999, Crooks and Soule 1999) of feral cats show that up to 70% of cats' prey is comprised of small mammals, up to 30% are birds, and the remainder of the diet is comprised of amphibians, reptiles, and insects. Birds that nest or feed on the ground are susceptible to cat predation, although cats are capable of catching birds by the wings and in trees. Loss et al. (2013) suggest that free-ranging domestic cats kill 1.3 to 4.0 billion birds and 6.3 to 22.3 billion mammals annually, and likely represent the greatest source of human-caused mortality (by virtue of cat ownership or support) for birds and mammals in the United States. They have been listed among the 100 worst non-native invasive species in the world (Lowe et al. 2000).

3.5.15.2 Feral cat population information

Today, cats may be the most widespread terrestrial carnivore on earth, with 74.1 to 85.8 million cats in the US, making cats the most popular pet in the country (AVMA 2012). However, there may be 60 to 120 million stray, free-ranging, and feral cats in the U.S (Jessup 2004, Winter 2004, Lebbin et al. 2010). Feral and free-ranging cats are common in certain areas of New Mexico. Feral and free-ranging cats are not managed by the State of New Mexico, and as such, there are no population estimates for feral and free-ranging cats.

Primary responsibility for cat control rests with county and local authorities or the resource owner/manager. However, because of New Mexico's cooperative wildlife damage management responsibilities and the seriousness of the problem, WS-New Mexico receives occasional requests to reduce feral cat damage by local authorities. WS-New Mexico personnel are authorized to control feral cats to protect livestock, poultry, natural resources, and human health and safety, when requested.

3.5.15.3 Feral cat population impact analysis

3.5.15.3.1 WS-New Mexico direct effects on feral cats

WS-New Mexico intentionally removed 2 feral and free-ranging cats between FY 2015 and FY 2019, and did not remove any cats unintentionally (Table 3.14).

The lethal removal of feral and free-ranging cats by WS-New Mexico is considered to have little impact on the human environment because feral and free-ranging cats are not indigenous to New Mexico. In addition, the annual numbers of feral and free-ranging cats removed by

WS-New Mexico is low compared to the thousands killed by animal control and humane organizations in New Mexico each year. The Humane Society estimates that 30 to 40 million cats are "community cats" (i.e., stray, abandoned, and/or feral, living outdoors) (http://www.humanesociety.org/issues/pet_overpopulation/facts/pet_ownership_statistics.html?referrer=https://search.yahoo.com/).

WS-New Mexico addresses feral and free-ranging cats at the request of the local authority for animal control and private individuals, thus, this action would likely occur in the absence of involvement by WS-New Mexico. WS-New Mexico expects the annual lethal removal of feral and free-ranging cats in New Mexico to remain similar to previous years. Therefore, WS-New Mexico does not set an annual maximum take level (Appendix D).

3.5.15.3.2 Cumulative mortality

Various non-WS sources of feral and free-ranging cat removals contribute to the cumulative take of feral and free-ranging cats in New Mexico (Table 3.14). However, while these non-WS sources of take are not recorded or reported to NMDGF, being primarily under the jurisdiction of local animal control departments, but are known to occur.

3.5.15.4 Conclusion: Feral cats

The cumulative impact of all recorded feral and free-ranging cat mortality in New Mexico, including potential intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico feral and free-ranging cat population.

Table 3.14. Population impact analysis of feral and free-ranging cat take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	0	0	0	0	2	0	2
WS unintentional take[1]	0	0	0	0	0	0	0
Total WS take	0	0	0	0	2	<1	2
Total Non-WS take	0	0	0	0	0	0	0
Cumulative take	0	0	0	0	2	0	2
Statewide population estimate[2]:							unknown
Annual maximum sustainable harvest:							unknown
Current total WS take as a % of the population:							unknown

Current cumulative take as a % of the population:	unknown
Projected WS annual maximum take[3]:	n/a
Projected total WS take as a % of the population:	n/a
Projected annual cumulative take as a % of the population:	unknown

[1] (MIS 2018).

[2] See Section 3.5.11.2 Feral and Free-Ranging Cat Population Information. Feral and free-ranging cats are not managed by NMDGF, and as such, there is no population estimate.

[3] See Section 3.5.11.3.1 WS-Direct Effects on Feral and Free-ranging Cats.

3.5.16 What are the direct and cumulative impacts on feral dog populations?

3.5.16.1 Feral dog life history

Feral and free-ranging dogs are somewhat common in certain areas in New Mexico, where they often run in packs and prey on and harass livestock and poultry. Free-ranging dogs may be subsidized by food provided by owners, and depredation and harassment may be recreational. They can also cause safety concerns for people through threats and attacks. Free-ranging and feral dogs are also known to prey on and harass native wildlife such as deer and upland game. Primary responsibility for dog control rests with state, county, and municipal authorities.

Feral and free-ranging dogs are not part of the native environment and when left abandoned in the wild, feral and free-ranging dogs pose ecological problems because they can prey on native wildlife. Feral and free-ranging dogs may also carry and spread diseases, such as rabies and Rocky Mountain spotted fever (Centers for Disease Control and Prevention 2015).

3.5.16.2 Feral dog population information

Feral and free-ranging dogs are not managed by the State in New Mexico and no population estimates are available. There are an estimated 83.3 million dogs in the United States, but it is unknown how many have become feral or free-ranging (Bergman et al. 2009).

Primary responsibility for dog control rests with state, county, and local authorities or the resource owner/manager. However, because of New Mexico's cooperative wildlife damage management responsibilities and the seriousness of the problem, WS-New Mexico personnel are authorized to respond to requests for assistance with feral and free-ranging dogs for the protection of livestock, poultry, and human health and safety, primarily on private and county or city lands (Table 2.2). Most dogs are taken by M-44's and neck snares (Table 2.1, Table E.1). Efforts to address damage associated with feral and free-ranging dogs would be conducted in accordance with WS Directive 2.340 (Section 2.4 A) for controlling dogs.

WS-New Mexico personnel do not conduct intentional lethal control of dogs and are only authorized to control feral or free-roaming dogs to protect livestock, poultry, and human health and safety when requested by the sheriff or other authority (WS Directive 2.340, Section 2.4.1.15). Consequently, most requests for assistance go to other agencies.

3.5.16.3 Feral dog population impact analysis

3.5.16.3.1 WS-New Mexico direct effects on feral dogs

WS-New Mexico did not intentionally remove any feral and free-ranging dogs per between FY 2015 and 2019 (Table 3.15). WS-New Mexico unintentionally removed an average of 4.2 feral and free-ranging dogs per year during the analysis period.

The lethal removal of feral and free-ranging dogs by WS-New Mexico has little impact on the human environment because feral and free-ranging dogs are not an indigenous component of ecosystems in New Mexico. WS-New Mexico addresses feral and free-ranging 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-New Mexico. WS-New Mexico expects the annual lethal removal of feral and free-ranging dogs in New Mexico to remain similar to previous years. Therefore, WS-New Mexico does not set an annual maximum take level (Appendix D).

3.5.16.3.2 Cumulative mortality

Various sources of feral and free-ranging dog removals contribute to the cumulative take of feral and free-ranging dogs in New Mexico (Table 3.15). Other non-WS sources of take of feral and free-ranging dogs are not recorded or reported to NMDGF, but are known to occur.

3.5.16.4 Conclusion: Feral dogs

Feral and free-ranging dogs are not an indigenous component of New Mexico ecosystems and are taken under very limited circumstances. Therefore, WS-New Mexico concludes that the cumulative impact of all recorded feral and free-ranging dog mortality in New Mexico, including intentional and unintentional take by WS-New Mexico, would not adversely impact the size or sustainability of the New Mexico feral and free-ranging dog population.

Table 3.15. Population impact analysis of feral and free-ranging dog take in New Mexico, FY 2015- FY 2019.

Mortality source	2015	2016	2017	2018	2019	5-year average	5-year high
WS intentional take[1]	0	0	0	0	0	0	0
WS unintentional take[1]	4	9	6	1	1	4.2	9
Total WS take	4	9	6	1	1	4.2	9
Total non-WS take	0	0	0	0	0	0	0
Cumulative take	4	9	6	1	1	4.2	9
Statewide population estimate[2]**:**							unknown
Annual maximum sustainable harvest:							unknown
Current total WS take as a % of the population:							unknown

Current cumulative take as a % of the population:	unknown
Projected WS annual maximum take[3]:	n/a
Projected total WS take as a % of the population:	n/a
Projected annual cumulative take as a % of the population:	unknown

[1] (MIS 2018).

[2] See Section 3.5.14.2 Feral and Free-ranging Dog Population Information. Feral and free-ranging dogs are not managed by NMDGF, and as such, there is no population estimate.

[3] See Section 3.5.14.3 WS-Direct Effects on Feral and Free-ranging Dogs.

3.5.17 What are the comparative impacts of the alternatives on predator populations?

3.5.17.1 Alternative 1. Proposed action/no action alternative: Continue WS-New Mexico PDM assistance.

The take for all target predator species by WS-New Mexico on all land classes is presented for each species as a yearly total and five-year average for FY 2015- FY 2019 (Tables 3.2 through 3.15) and summarized in Table 3.16. Between FY 2015 and FY 2019, the target species with the greatest average yearly take by WS-New Mexico for PDM were coyotes (*n*=3,774) and striped skunks (*n*=593). All other predator species intentionally taken by WS-New Mexico are at an average of less than 20 per year. Table 2.2 provides intentional lethal take proportions for the top 99% of predators as: coyotes (86%) and striped skunks (13.3%).

Virtually all resource owners have used or attempted one or more non-lethal methods on their own prior to non-lethal and/or lethal assistance from WS-New Mexico. Environmental factors that may impact the extent to which animals are attracted to human-related food sources; fluctuations in livestock markets and herd population dynamics; predator population dynamics; range expansion by predators, humans, pets, and livestock; and PDM funding fluctuations affect WS-New Mexico's capability to respond to requests for assistance. Regardless, WS-New Mexico expects that intentional take of predators in the foreseeable future will be similar to levels recorded from FY 2015 through FY 2019.

For all predator species in New Mexico included within the scope of this EA, the annual statewide known cumulative take is below or at the annual maximum sustainable harvest level (Tables 3.3 through 3.16) as determined by a review of the available scientific literature. As indicated in the summary Table 3.16, the current cumulative take as a percentage of the population is at or below the annual maximum sustainable harvest level for all species indicating that cumulative take of all species is not likely to adversely affect the statewide predator populations.

The proportion of take by WS-New Mexico compared to the highest cumulative take shows that WS-New Mexico has substantially lower total and proportional take of all species except striped skunks compared to non-WS sources. WS-New Mexico only takes 3.7% of the cumulative take of coyotes compared to 5.5% for other sources of known mortality, 0.4% of the cumulative take of cougars compared to 10% for other sources of mortality, 0.1% of the cumulative take of black bears compared to 9.8% for other sources of mortality, and 0.1% of the cumulative take of bobcat compared to 6.7% for other sources of mortality. Even considering the projected WS annual maximum take, WS-New Mexico take for every species is below the annual maximum sustainable harvest level to ensure healthy and stable or increasing predator populations.

All predator species populations targeted by WS-New Mexico are stable as determined by NMDGF (Stewart Liley, NMDGF, pers. comm., 8/15/2018). Populations of free-ranging/feral cat and feral/free ranging dog populations are unknown, and many free-ranging cats and dogs live with and are subsidized by their owners. Cumulative take and WS-New Mexico's direct incremental contribution to that cumulative take are substantially below the maximum sustainable harvest levels for all species. Even with unknown take, all predator populations continue to be healthy and sustainable as determined by NMDGF and these analyses. WS-New Mexico is not and would not adversely impact any native predator populations.

Table 3.16. Summary of WS-New Mexico intentional take and known cumulative take, FY 2015- FY 2019[1].

Species	Current total WS take as a % of the population[2]	Current cumulative take as a % of the population[3]	Projected annual cumulative take as a % of the population[4]	Annual maximum sustainable harvest[1]
Coyote	4.1%	8.97%	10.7%	60%
Black Bear	0.08%	7.8%	10.13%	10%
Striped Skunk	0.59%	1.11%	2.96%	60%
Hog-nosed Skunk	<0.01%	0.08%	0.1%	10%
Raccoon	<0.01%	0.78%	0.85%	16.5%
Cougar	0.28%	13.57%	14.56%	24%
Gray Fox	0.15%	8.5%	8.7%	20%
Kit Fox	0.07%	1.68%	1.93%	20%
Swift Fox	0.11%	0.95%	1.11%	20%
Red Fox	0.02%	4.2%	4.3%	20%
Badger	0.07%	1.23%	1.36%	10%
Bobcat	0.08%	5.2%	5.3%	10%
Feral and Free-ranging Cat	--	--	--	unknown
Feral and Free-ranging Dog	--	--	--	unknown

[1] These data are from Tables 3.3 through 3.16. All percentages rounded to nearest 0.01%
[2] The proportion of the estimated species population taken by WS-New Mexico in the year with the highest WS-New Mexico take between FY 2015- FY 2019.
[3] The proportion of the estimated species population taken by all sources in the year with the highest take between FY 2015- FY 2019.
[4] Provides a conservative estimate of the highest proportion of the estimates species population that could be taken by all sources, under projected WS annual maximum take scenario.

3.5.76.2 Alternative 2. WS-New Mexico provides both lethal and nonlethal technical PDM assistance and nonlethal operational assistance.

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners would likely continue to conduct PDM activities as described in Section 3.4, with reported take incorporated into the cumulative impact analysis, as in Alternative 1. Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

With this alternative, WS-New Mexico 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 (as discussed in Section 3.4). Relatively few WCOs are available for large predator species damage management, but landowners can request someone to work as their agent. 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-New Mexico employees. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting PDM activities for those particular species (Section 3.4.2).

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. Depending on the readiness and interest of other entities to conduct PDM activities, the cumulative number of predator removals could be greater than, less than, or similar to the cumulative take under Alternative 1. It is possible that more predators could be taken by other entities, as a result of less selective removals. Conversely, fewer predators may be removed in the absence of lethal operational assistance from WS-New Mexico because there may be fewer entities readily available to help address conflicts, individuals experiencing damage may not take action themselves, and/or individuals may be less efficient in taking action themselves. Lastly, there is the potential for predators to be removed by other entities at a similar level to WS-New Mexico's lethal take under Alternative 1.

Under Alternative 2, other entities would be expected to have a level of take similar to the cumulative take under Alternative 1. Predator populations are expected to be stable. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. Further, cumulative take would not near annual maximum sustainable harvest levels established for the predator species, despite any reasonably foreseeable levels of increased take by other entities.

3.5.17.3 Alternative 3. WS-New Mexico provides nonlethal PDM assistance before recommending or applying lethal assistance.

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. Lethal methods applied by WS-New Mexico would have similar impacts on predator populations as those analyzed under Alternative 1. Non-lethal methods would not likely contribute substantially to direct or cumulative impacts on predator species. The APHIS-WS Decision Model may not be fully effective because if they are deemed necessary, lethal actions could not be used by WS-New Mexico during the time that non-lethal methods are attempted to address the immediate problems. Other commercial, governmental, and private entities and landowners would be likely to continue to conduct PDM activities as described in Section 3.4.

Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners could use trained and experienced WCOs or may implement lethal methods themselves. However, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4).

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-New Mexico employees. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1.

Cumulative levels of take would be expected to be similar to Alternative 1 and would not be expected to near the maximum sustainable harvest levels for predator species. Therefore, predator populations are expected to be stable with similar levels of impacts as under Alternative 1.

3.5.17.4 Alternative 4. WS-New Mexico provides PDM lethal assistance only for cases of human/pet health or safety and/or to protect threatened or endangered species.

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal methods would only be used when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. When WS-New Mexico responds with lethal PDM under the limited circumstances allowable under this alternative, the impacts on predator populations from WS-New Mexico would be less than those described for Alternatives 1 and 3, because fewer predators would be removed under this alternative. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities as described in Section 3.4. Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

However, since WS-New Mexico would not be able to respond with lethal methods to damage or threats to any other resources or situations. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). 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-New Mexico employees. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1.

Cumulative levels of take would be expected to be similar to Alternative 1 and would not be expected to near the maximum sustainable harvest levels for predator species. Therefore, predator populations are expected to be stable with similar levels of impacts as under Alternative 1.

3.5.17.5 Alternative 5. No WS-New Mexico PDM activities

Under this alternative, WS-New Mexico would have no effect on predator populations. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

Without WS-New Mexico's technical and operational assistance, other entities may be less efficient and effective at resolving the PDM situation, potentially resulting in more predators being taken. 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-New Mexico employees. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1.

In the absence of WS-New Mexico's assistance, the effects on predator species populations would likely be higher than under Alternatives 1-4.

3.6 IMPACTS ON T&E SPECIES

WS-New Mexico is responsible for ensuring its actions are in compliance with the federal Endangered Species Act (ESA) which is the focus of this section. The State of New Mexico also has an ESA (NMSA 17.2.41), but its prohibitions and reach is less broad than the federal ESA. Most of the NMDGF threatened and endangered species are also included on the federal list and therefore have been considered in this EA. Federal ESA always trumps the NMDGF ESA if the protections are more stringent.

3.6.1 How has WS-New Mexico considered potential impacts on threatened and endangered species?

As a federal agency, WS-New Mexico reviews its proposed activities for the potential to affect federally-listed threatened and endangered (T&E) species. When WS-New Mexico determines a listed species may potentially be affected by its activities in any way, it consults with the USFWS pursuant to Section 7 of the ESA. WS-New Mexico has completed informal and formal consultation with the USFWS for effects from all of its activities on federally-listed T&E species. The effects analyses and findings pertinent to this EA are based on the WS-New Mexico Biological Assessment (BA) for all WDM activities in 2014 (WS 2014) which resulted in a concurrence letter issued December 2014 (USFWS 2014).

PDM activities have the potential to affect the Mexican wolf, jaguar, lynx, lesser prairie chicken, and Mexican spotted owl. Details can be found in those documents for all of the *may affect* species. In the formal consultation, Reasonable and Prudent Alternatives (RPA) or Reasonable and Prudent Measures (RPM) were addressed along with an incidental take statement (IT), where appropriate, with their terms and conditions (T/C). The black-footed ferret is an experimental population on Moore Ranch where WS does not work. Should the need for PDM in this area arise, WS will consult further with the USFWS for this species. The pertinent descriptions of

WS-New Mexico PDM activities that are incorporated into the Biological Opinion and in the informal consultation are included in Section 2.3.1 for Alternative 1 and detailed in Appendix A.

WS-New Mexico determined that their PDM activities, either would have no effect or may affect, but were not likely to adversely affect (NLAA) federally-listed T&E species. The USFWS defines NLAA as any effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any adverse effects on the species or habitat. Insignificant effects relate to the size of the impact and include those impacts that are undetectable, not measurable, or cannot be evaluated. Discountable effects are those that are extremely unlikely to occur (USFWS and NOAA 1998).

3.6.2 Which T&E species would not be affected by WS-New Mexico PDM Activities?

WS-New Mexico has determined that its PDM activities would have no effect on some T&E species because WS-New Mexico does not conduct PDM in areas where or in a manner that would affect these species. Species that would not be affected by WS-New Mexico PDM activities are listed below.

- **Species of fish:**

Headwater Chub (*Gila nigra*), Roundtail Chub (*Gila robusta*), Beautiful Shiner (*Cyprinella Formosa*), Woundfin (*Plagopterus argentissimus*)

- **Species of mammals:**

Black-footed ferret (*Mustela nigripes*), Peñasco Least chipmunk (*Neotamias minimus atristriatus*)

- **Species of birds:**

Northern Aplomado Falcon (*Falco femoralis*)

- **Species of invertebrates:**

Socorro Isopod (*Thermosphaeroma hermophilum*), Noel's Amphipod (*Gammarus desperatus*), Roswell Springsnail (*Pyrgulopsis roswellensis*), Koesters Springsnail (*Juturnia kosteri*), Pecos Assiminea Snail (*Assiminea pecos*), Socorro Springsnail (*Pyrgulopsis neomexicana*), Chupadera Springsnail (*Pyrgulopsis chupaderae*), Alamosa Springsnail (*Pseudotryonia alamosae*), Texas Hornshell (*Popenaias popeii*)

- **Species of reptiles and amphibians:**

New Mexican ridge-nosed rattlesnake (*Crotalus willardi obscurus*), The Northern Mexican Gartersnake (*Thamnophis eques megalops*), Narrow-headed Gartersnake (*Thamnophis rufipunctatus*).

- **Species of plants:**

Sacramento Prickly Poppy (*Argemone pleiacantha pinnatisecta*), Mancos Milk-vetch (*Astragalus humillimus*), Sacramento Mtns. Thistle (*Cirsium vinaceum*), Lee Pincushion Cactus (*Coryphantha sneedii leei*), Sneed Pincussion Cactus (*Coryphantha sneedii sneedii*)
Kuenzler Hedgehog Cactus (*Echinocereus fendleri kuenzleri*), Knowlton's Cactus (*Pediocactus knowltonii*), Mesa Verde Cactus (*Sclerocactus mesae-verdae*), Zuni Fleababe (*Erigeron rhizomatus*), Gypsum Wild-buckwheat (*Eriogonum gypsophilum*), Todsen's Pennyroyal (*Hedeoma*

todsenii), Pecos Sunflower (*Helianthus paradoxus*), Holy Ghost Ipomopsis (*Ipomopsis sancti-spiritus*)

3.6.3 Which T&E species may be affected by WS-New Mexico PDM activities?

WS-New Mexico has determined that some animal and plant species may be affected by some aspects of PDM, but all but the Rio Grande cutthroat trout and Mexican gray wolf were not likely to be adversely affected (NLAA). The effects analysis for each of these species, based on USFWS consultations, is summarized in Table 3.17.

Table 3.17. Federally-listed Threatened and Endangered Species Potentially Affected by PDM Activities in New Mexico

Species	Federal ESA Status	Effects Determination
Rio Grande Silvery Minnow (*Hybognathus amarus*)	Endangered	NLAA[1]
Gila Trout (*Oncorhynchus gilae*)	Threatened	NLAA[1]
Colorado Pikeminnow (*Ptychocheilus lucius*)	Endangered	NLAA[1]
Gila Chub (*Gila intermedia*)	Endangered	NLAA[1]
Chihuahua Chub (*Gila nigrescens*)	Threatened	NLAA[1]
Loach Minnow (*Rhinichthys (Tiaroga) cobitis*)	Endangered	NLAA[1]
Pecos Bluntnose Shiner (*Notropis simus pecosensis*)	Threatened	NLAA[1]
Arkansas River Shiner (*Notropis girardi*)	Threatened	NLAA[1]
Razorback Sucker (*Xyrauchen texanus*)	Endangered	NLAA[1]
Zuni Bluehead Sucker (*Catostomus discobolus yarrowi*)	Endangered	NLAA[1]
Pecos Gambusia (*Gambusia nobilis*)	Endangered	NLAA[1]
Gila Topminnow (*Poeciliopsis occidentalis occidentalis*)	Endangered	NLAA[1]
Rio Grande Cutthroat Trout (*Oncorhynchus clarkii virginalis*)	Candidate	NLTJ[2]
Spikedace (*Meda fulgida*)	Endangered	NLAA[1]
Mexican Gray Wolf (*Canis lupus baileyi*)	Endangered – 10(j)	NLTJ
Canada Lynx (*Lynx canadensis*)	Threatened	NLAA[1]

Jaguar ***(Panthera onca)***	Endangered	NLTJ
Mexican Long-nosed Bat **(*Leptonycteris nivalis*)**	Endangered	NLAA[1]
New Mexico Meadow Jumping Mouse **(*Zapus luteus luteus*)**	Endangered	NLAA[1]
Piping Plover **(*Charadrius melodus*)**	Threatened	NLAA[1]
Least Tern **(*Sternula antillarum*)**	Endangered	NLAA[1]
Yellow-billed Cuckoo **(*Coccyzus americanus occidentalis*)**	Threatened	NLAA[1]
Mexican Spotted Owl **(*Strix occidentalis lucida*)**	Threatened	NLAA[1]
Lesser Prairie-Chicken **(*Tympanuchus pallidicinctus)***	Threatened	NLAA[1]
Southwestern Willow Flycatcher **(*Empidonax traillii extimus*)**	Endangered	NLAA[1]

[1] May affect, not likely to adversely affect
[2] May affect, not likely to jeopardize

3.6.4 What are the potential effects on specific T&E species?

3.6.4.1 Rio Grande silvery minnow

This minnow is classified as an endangered species in the Rio Grande River drainage but has been extirpated over 90% of its historic range in New Mexico, including other river basins. It is now found in the perennial reaches of the Rio Grande from Santo Domingo Pueblo to Socorro in variable abundances. This minnow prefers mainstream habitats with slow to moderate water velocities, moderate depth (8" - 32"), with sand or silt bottoms where it presumably feeds on herbaceous matter. These minnows are pelagic broadcast spawners and eggs can float for more than a day before settling; river impoundments can impede this action. During winter, they are more likely to be found in still waters with debris cover and substrate (potentially beaver ponds). In addition, young are sometimes found in irrigation ditches and canals. This species is thought to have declined as a result of habitat modifications (channelization, channel incision, impoundments, decreased water quality, flow reductions, range fragmentation, and stream desiccation) and the establishment of nonnative fishes (predation and interspecific competition) (NMDGF 2012). PDM methods are not likely to negatively impact this species. The USFWS concurred with WS that WDM methods in designated critical habitat or the currently occupied range, are not likely to adversely affect this species. WS will further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.2 Gila trout

These endangered salmonids were historically native to cold water reaches in the Gila River, including the San Francisco River, and Verde River drainages in Southwestern New Mexico and

Arizona. Recently fish were stocked into Dude and Raspberry Creeks. Gila trout are found primarily in clear, cool headwater mountain streams with gravel bottoms, low siltation, and deep pool habitat (Propst et al. 1992, NMDGF 2012). Declines in the Gila trout population have been linked to the introduction of nonnative fishes, particularly competition and predation from brown trout (*Salmo trutta*) and competition and hybridization with rainbow trout (*Oncorhynchus mykiss*). In addition, historic land use practices such as logging and road construction and natural disasters such as floods, fires and droughts have contributed to their decline (Propst 1992, NMDGF 2012). PDM impacts on aquatic species are limited to crossing streams and rivers in trucks, on ATV's, or by foot. These activities are not likely to negatively impact this species. The USFWS concurred with WS that the current WS WDM program may affect but is not likely to adversely affect this species. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.3 Colorado pikeminnow

The largest minnow in North America, the pikeminnow formerly known as "Colorado squawfish" can attain a length of 6 feet and weigh 80 pounds. It is dusky-green in color with a long head and large mouth. It prefers turbid turbulent rivers with seasonal flows. Historically, the pikeminnow occurred in great numbers throughout the Colorado River system from Green River in Wyoming to the Gulf of California in Mexico. In Colorado, they are currently found in the Green, Yampa, White, Colorado, Gunnison, San Juan, and Dolores Rivers. The fish occurs in the warm, swift waters of the big rivers of the Colorado Basin. Adults are migratory and inhabit pools and eddies just outside the main current of rivers. Young can be found in backwater areas. Dam construction and other water diversion projects along the Colorado River system contributed to its decline. The introduction of nonnative bait minnows and stocking of predatory game fish species are suspected to have contributed to their decline as well. Recovery actions are underway to remove nonnative fish, construct bypasses around in-stream barriers, and restock pikeminnow into native habitat by other agencies, but not WS. WS PDM activities would not significantly impact this species. The USFWS concurred that the current WS WDM program may affect but is not likely to adversely affect this species. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.4 Gila chub

Historically, Gila chub have been recorded from rivers, streams, and spring-fed tributaries throughout the Gila River basin in southwestern New Mexico, central and southeastern Arizona, and northern Sonora, Mexico. Today the Gila chub has been restricted to small, isolated populations scattered throughout its historical range. Gila chub require a habitat that contains a combination of perennial pools, areas of higher velocity between pools, and areas of shallow water among plants or eddies all found in headwaters, springs, and cienegas. These habitats also need cover consisting of downed logs and other woody cover, submerged aquatic vegetation, undercut banks, large rocks and boulders with overhangs, and a healthy, intact riparian vegetation community. They also need habitats that lack exotic aquatic species detrimental to Gila chub or habitat in which detrimental exotic species are kept at a level that allows Gila chub to continue to survive and reproduce. Gila chub currently occur in Turkey Creek in New Mexico, and about 24 streams of the Agua Fria, Gila, Santa Cruz, and San Pedro drainages in Arizona. This species could benefit from nonnative species removal. PDM activities would not negatively impact this species. The USFWS concurred with WS that the current WS WDM program may affect but is not likely to adversely affect this species. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.5 Chihuahua chub

This federally listed threatened species occurs in a small length (5miles) of the Mimbres River basin and now only regularly found in the Moreno Spring area. It occupies moderately deep pools, especially lateral scours, in streams adjacent to high velocity runs. It is associated with vegetated undercut banks, boulders, and fallen logs with a stream bottom substrate of pea gravel and sand. It has been severely impacted by nonnative fish and habitat modifications (Propst and Stefferud 1994, NMDGF 2012). In many areas, Chihuahua chubs are absent if introduced species such as rainbow trout are present. Because the Chihuahua chub prefers deep pools immediately adjacent to swift runs, it would not be adversely affected by any WDM activities. The USFWS has concurred that the current WS WDM program may affect but is not likely to adversely affect this species because actions would be discountable or beneficial. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.6 Loach minnow

A small elongated fish with olive coloration and dull white spots at the base of its dorsal and caudal fins. It is a benthic dweller of perennial creeks and rivers of the Gila River system. It prefers shallow riffles with cobbled bottoms, swift currents, and filamentous algae. Habitat loss and degradation have been due to damming, channelization, riparian zone destruction, water diversion and groundwater pumping; and the introduction and spread of invasive predatory and competitive fish species. PDM activities would not significantly impact the loach minnow in NM. USFWS has determined that the current WS WDM program may affect but is not likely to adversely affect this species. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.7 Pecos bluntnose shiner and Arkansas river shiner

These two federally listed threatened shiner species are found in separate areas in New Mexico, the Pecos and South Canadian River Basins, but have similar habitat requirements and reasons for decline. Both species prefer mainstem channels of rivers and streams with low velocities over sandy and sometimes gravelly substrates. However, both species can be found in many other stream habitats. Both species are broadcast spawners and their eggs can stay adrift for more than a day. Declines in these species have mostly been attributed to stream desiccation as a result of the recent drought, dams, and diversion (NMDGF 2012). Decline in water quality, river channelization, and competition with and predation by nonnative species have also been considered contributing factors in their decline. These species prefer sandy substrate (not sediment as in a beaver pond) in low velocity waters (not relatively still to very slow as behind a beaver dam). WS PDM activities such as crossing streams and rivers in trucks or ATV's would have minimal impact on these species as WS field staff typically cross these areas on bridges. The USFWS has concurred that the current WS WDM program may affect, not likely to adversely affect this species because actions would be discountable or beneficial. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.8 Razorback sucker

This endangered sucker's critical habitat includes rivers in Colorado, Utah, portions of the Colorado River in Arizona, California, and Nevada, and portions of the Gila, Salt, and Verde rivers in Arizona. The razorback sucker is endemic to the Colorado River Basin. Small populations of razorback suckers exist in the Upper Basin in the Green River Basin (the Green, Duchesne, White, and Yampa Rivers) and the main branch of the Colorado River in Colorado and Utah. In the Lower Basin, wild razorback sucker populations are known from Lake Mead and Lake Mohave. A very few wild individuals may still be found below Lake Mohave to Imperial Dam. Predation and competition from nonnative fish species introduced into the Colorado River basin pose the greatest threat to the razorback sucker. Other significant threats to the razorback sucker include loss of riverine and backwater habitats, loss of connectivity of habitats, and changed inflows due to water development. The USFWS has determined that the current WS WDM program may affect, not likely to adversely affect this species. NM WS will further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.9 Zuni bluehead sucker

This federal proposed endangered species once inhabited the headwater streams of the Little Colorado River in west-central New Mexico. It is now limited to areas of the upper Rio Nutria and Agua Remora. It is found in stream reaches with abundant shade, pool and riffle habitat and low water velocities. The habitat substrate is typically dominated by bedrock, boulders and large cobble; they are noticeably absent where sand and silt are the substrate. Declines in their population have been attributed to past land use practices that increased soil erosion in the watershed, thereby decreasing their preferred habitat, and fish eradication efforts in the 1960s to establish a trout fishery. In addition, several piscivorous fish species have been introduced that likely have had an impact from predation (NMGF 2012). USFWS has determined that the current WS WDM program may affect but is not likely to adversely affect this species. WS will further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.10 Pecos gambusia

This federally endangered species is native to springs and spring systems with permanent water in the Pecos River basin of southeastern New Mexico. They inhabit areas with an abundance of aquatic vegetation, overhanging banks, and submerged cliffs. Suitable habitat for the gambusia often has minimal water velocities which are not necessarily very deep. Groundwater pumping in several areas has eliminated the gambusia at these sites. In addition to this threat, hybridization with a similar species in their genus, and competition with and predation from nonnative species are also concerns (NMDGF 2012). WS PDM activities will have no effect on this species and the USFWS has determined that the current WS WDM program may affect but is not likely to adversely affect this species. NM WS will further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.11 Gila topminnow

This federally endangered species was native only to a series of stenothermal warm springs along the San Francisco River in New Mexico where it has been extirpated. It now only occurs at scattered locations in the Gila River system of Arizona. They inhabited areas with an abundance of aquatic vegetation and protected banks. Suitable habitat for the topminnow often has warm waters with minimal water velocities that are fairly shallow. Loss of habitat, and competition with and predation from nonnative species are primary concerns for their decline (NMDGF 2012). Many reintroduction efforts in New Mexico were unsuccessful, but a few recent ones have been and are being monitored (NMDGF 2012). PDM will have little or no effect on this species. The USFWS has determined that the current WS WDM program may affect but is not likely to adversely affect this species because actions would be discountable or beneficial. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.12 Rio Grande cutthroat trout

Cutthroat trout prefer clear, cold streams and lakes with 50% riffle and 50% pool providing ideal habitat conditions. Cutthroat trout are opportunistic feeders. Terrestrial insects may account for most of the diet during summer months. Aquatic invertebrates are most abundant and diverse in riffle areas and the trout will feed heavily in, and especially downstream of, these areas. Cutthroat will also feed on zooplankton and crustaceans. As they get bigger, cutthroats become more piscivorous. Eggs are laid in gravel nests built in flowing water. The distribution of the Rio Grande cutthroat trout is further south than any other cutthroat trout, historically occupying the colder reaches of streams in the mountainous portions of the Rio Grande, Canadian, and Pecos River drainages in Colorado and New Mexico. In Colorado, their range is confined to the headwaters of the Rio Grande surrounding the San Luis Valley. Much of their present range is on federally owned lands (USFS, BLM, and NPS). Declines in the Rio Grande cutthroat trout population have been linked to the introduction of nonnative fishes, particularly competition and hybridization with the rainbow trout (Onchorhynchus mykiss). As with other subspecies of cutthroat trout, introductions of nonnative salmonids over the last century have served to limit their current distribution to isolated headwater streams and lakes. A Conservation Agreement (Rio Grande Cutthroat Trout Conservation Team 2013) provides a collaborative framework among state, federal, and tribal resource agencies outlining long-term conservation objectives for this subspecies. This species population declined primarily as a result of the loss of habitat and hybridization, competition, and predation by invasive aquatic species.

This species will inhabit smaller streams and ponds, and other wetlands and has the potential to be impacted by aquatic rodent damage management but not by PDM activities. NM WS concluded, and the USFWS agreed, that WDM in New Mexico may affect but is not likely to adversely affect the trout.

3.6.4.13 Spikedace

A relatively nondescript small silvery fish found in medium to large streams with moderate to fast velocity waters over rocky, gravelly substrates. Once found throughout much of the Gila River Drainage in suitable habitat, it is now known from only a few locations within its historic range. The causes of their decline are thought to be habitat loss and degradation, and competition and depredation from invasive aquatic species. This species could benefit from nonnative species removal where present and identified as contributing to their decline. WS has determined that the current WS WDM program may affect, not likely to adversely affect this species. WS would further consult on projects in occupied, proposed, and designated critical habitat.

3.6.4.14 Mexican Gray Wolf

The gray wolf, including the Mexican subspecies, was extirpated from much of the lower 48 continental United States in the first half of the twentieth century. The Mexican wolf population once inhabited areas in Arizona, New Mexico, Texas, and Mexico, but they were probably extirpated from the U.S. by 1970 with the last verified report of a wild wolf; and may altogether be extirpated now in Mexico. Fortunately, captive Mexican wolves were available for their recovery. In 1998, wolves were reintroduced in Arizona and New Mexico as an NEP under section 10(j) of the Endangered Species Act which is outlined in the Wolf Recovery Plan. WS completed consultation/conferencing with USFWS for the Mexican gray wolf in 1998 and again in 2011. Many tools used in WDM for large predators such as foothold traps, snares, M-44s, and aerial hunting have the potential of taking a wolf. WS followed the conservation measures established in the 1998 Biological Opinion and Conference Opinion issued by USFWS (1998); this was actually two opinions - a "BO" for "naturally occurring wolves" and a "Conference Opinion" for the reintroduced wolf NEP. However, it is believed that the natural occurring wolves have been extirpated and only the NEP wolves remain. WS reinitiated a new consultation for wolves found outside the New Mexico and Arizona NEP designated area or those potentially wandering into the United States from a release being planned in Mexico, areas where they are considered endangered, and in National Parks or Wildlife Refuges where they are treated as threatened species. WS also requested a new Conference for the NEP wolves in the NEP zone. USFWS (2011) provided a BO for the wolves found in these situations which replaced the existing BO and Conference Opinion (USFWS 1998). WS is sometimes asked to capture wolves that wander away from the NEP area for USFWS under a separate permit and return them to the NEP area. WS will abide by the Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T/Cs) of the BO (USFWS 2011). WS has agreed to the following implementation measures:

1. WS shall coordinate WDM Program activities to reduce the likelihood of impact to the species by contacting the FWS-New Mexico Ecological Services Field Office (NMESFO), the FWS Mexican Wolf Recovery Program Coordinator, the Mexican Wolf Interagency Committee(s), the Mexican Wolf Interagency Field Team, and other appropriate Federal, State, and Tribal agencies prior to conducting WDM Program activities in Mexican wolf range.

2. WS personnel who conduct WDM Program activities in occupied wolf range shall be knowledgeable at a professional level in identification of Mexican wolf, their habitat and use of habitat, and their sign.

3. WS shall release any Mexican wolf inadvertently captured alive, and report the incident to the Interagency Field Team located in Alpine, Arizona and NMESFO within 24 hours, unless: (A) the animal has sustained an injury which appears to be life threatening without veterinary attention; or (B) protocol has been established and agreed to with the NMESFO for handling, marking, radio-collaring, or maintaining such animals in captivity. If an animal sustained a serious injury, WS shall take immediate steps to report the incident to the NMESFO and proceed under their direction.

4. WS shall establish a 25-mile radius around the point of any incidental take of a naturally-occurring Mexican wolf. The area shall be treated as occupied Mexican wolf range or habitat until further investigation and surveys can be conducted. WS shall cease the activity resulting in the take, as well as all other activities with the potential to incidentally take Mexican wolf in the occupied range, and shall immediately reinitiate consultation with the FWS.

5. When conducting predator damage management activities for species other than Mexican wolves in occupied Mexican wolf range, WS shall conduct a daily trap check while using padded jaw traps with a jaw spread equivalent to #3 soft catch or larger or foot or leg snares. Traps shall be equipped with a drag in those cases where there is some question that the stake might not hold a wolf (i.e., loose soil) and connections shall be welded or otherwise securely fastened. All traps have the potential to capture juvenile wolves, and therefore, shall not be used in proximity to occupied dens and rendezvous sites from June 1 to October 1 unless Mexican wolf is targeted for a control action.

6. WS shall not use M-44 devices, LPCs, and neck snares without break away devices in occupied Mexican wolf range unless approved on a case-by-case basis by the FWS or the FWS's designated agent. Neck snares shall not be used near den or rendezvous sites unless they are being used to specifically target Mexican wolf. For the Mexican wolf, M-44 devices, LPCs, and neck snares shall not be used within a 5-mile buffer around pack home ranges or individual tracks or locations (see definition of occupied habitat).

In addition WS will adhere to the following RPM's to minimize impacts of incidental take of Mexican wolf by WS personnel conducting WDM Program activities outside the boundaries of the Mexican Wolf Experimental Population Area and also within the boundaries of the National Wildlife Refuge System lands and National Park System/National Monument lands located inside the Mexican Wolf Experimental Population Area boundaries.

1. WS will assist the FWS and appropriate Federal, State, and Tribal agencies by maintaining interagency coordination and information exchange; and by reporting occurrences, livestock depredations, and incidental take of Mexican wolf.

2. WS will implement measures and adjust its normal WDM Program activities in occupied Mexican wolf range to minimize incidental take of Mexican wolf in accordance with the terms and conditions below. WS' measures and adjustments of WDM Program activities in the southwestern United States will minimize the potential for WDM Program activities to adversely impact the species.

WS will comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements.

The following terms and conditions implement Reasonable and Prudent Measure #1.

1. WS shall maintain regular (annual or more frequent) contact and coordination with the FWS Mexican Wolf Recovery Program Coordinator, Interagency Committee(s), the Mexican Wolf Interagency Field Team, the NMESFO, and other appropriate Federal, State, and Tribal agencies to keep apprised of locations and information on the presence of Mexican wolf.

2. WS shall report the incidental take of Mexican wolf to the NMESFO, State, and Tribal wildlife agencies within 24 hours. Additional time shall be allowed for remote areas with limited access. Cause of death or injury shall be reported, if known.

3. WS shall notify the NMESFO and appropriate State and Tribal agencies of any Mexican wolf occurrence.

4. WS shall notify the appropriate officials, including but not limited to the FWS Mexican Wolf Recovery Program Coordinator, Interagency Committee(s), the Mexican Wolf Interagency Field

Team, and the NMESFO when WS has evidence suspecting Mexican wolf predation on livestock or threat to public health and safety.

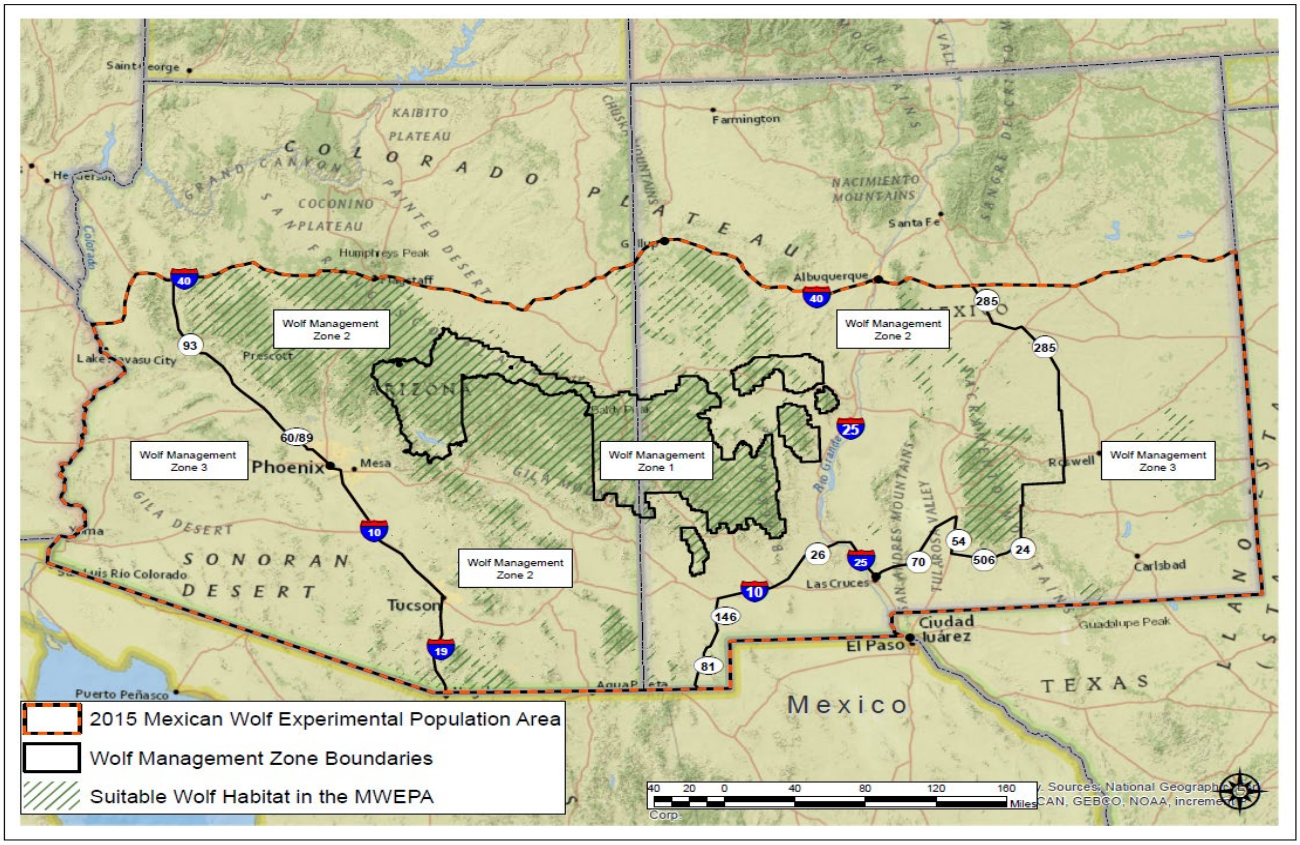
5. WS shall provide FWS with an annual monitoring report of incidental take of Mexican wolf.

The following condition implements Reasonable and Prudent Measure #2.

1. WS shall ensure that personnel implementing WS WDM Program activities follow the Implementing Procedures above.

In January 2013 a NM WS employee accidentally shot a yearling Mexican gray wolf after mistaking it for a coyote. In response WS developed SOP's limiting circumstances including shooting distance and night hunting, to avoid future inadvertent take of a Mexican wolf. They include:

1) Within Zone 1 of the Mexican Wolf Experimental Population Area (MWEPA), NM WS employees may not shoot at canids beyond a distance of 100 yards, unless authorized by USFWS for wolf removal.
2) Outside of Zone 1 but within the MWEPA, NM WS employees may not shoot at canids beyond a distance of 100 yards when wolves are known to be in the area, unless authorized by USFWS for a wolf removal.
3) Within the Zone 1 of the MWEPA, NM WS employees may not conduct night shooting activities for canids including the use of spotlights, starlight scopes, infrared, or other night vision devices unless authorized by USFWS for wolf removal.
4) Outside of Zone 1, but within the MWEPA, NM WS employees may not conduct night shooting activities including spotlighting, using starlight scopes, infrared, or other night vision devices when wolves are known to be present, unless authorized by USFWS for wolf removal.
5) NM WS employees may not conduct "opportunistic" shooting of canids from vehicles within Zone 1 of the MWEPA. Opportunistic shooting is defined as shooting at a canid from a vehicle when it is observed from a distance. WS will only shoot at canids in this area when shooting over a carcass or draw station from outside the vehicle or in a predator calling situation, unless authorized by the USFWS for Mexican wolf removal.
6) Outside of Zone 1, but within the MWEPA, NM WS employees may not conduct "opportunistic" shooting of canids from vehicles when wolves are known to be present.



In 2014, the USFWS concurred with WS determination that WDM activities may affect but would not likely jeopardize the Mexican gray wolf.

3.6.4.15 Canada Lynx

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. Colorado was considered the southern extreme of its range, and possibly northern New Mexico, but this was never documented. The Canada lynx was reintroduced into southwestern Colorado from 1999 to 2006 (n = 218) by the Colorado Division of Wildlife (now known as Colorado Parks and Wildlife) and some of these reintroduced lynx travelled into northern New Mexico. Most returned to Colorado after short-lived forays in New Mexico, but 14 non-WS mortalities occurred. Most mortalities occurred shortly after reintroduction with their frequency decreasing significantly over time (Devineau et al. 2010). Even though lynx travelled into New Mexico, reproduction was never documented.

NMDGF does not list lynx on their endangered species list as they do not recognize them as a native species and USFWS did not designate critical habitat in New Mexico. When the lynx was considered for listing by USFWS (63 FR 36993-37013, July 8, 1998) it stated that "Colorado represents the extreme southern edge of the range of the Canada lynx." As such, New Mexico was not considered a state in its listed range. The lynx that have been reported in New Mexico have been primarily in their characteristic terrain of dense stands of subalpine forests in mountainous terrain.

WS PDM activities could potentially affect individual lynx with methods including neck and foot snares, leghold traps, M-44s, the livestock protection collar, and dogs. In more than 30 years of WS history for WDM activities conducted in or near lynx habitat in their native range, one lynx was taken in a leghold trap (in Idaho), but released alive. WS nationwide does not generally conduct extensive work in lynx-associated habitat, accounting for the low incident of take, because the primary predator that WS works with is the coyote which is less abundant in lynx habitat.

NM WS has agreed to implement the following conservation measures to minimize incidental take:

1. Provide training to WS personnel in the identification of lynx and lynx sign, and snowshoe hare and their sign if conducting predator damage management activities within lynx habitat.

2. WS personnel will not use fetid baits and attractants in coyote sets within lynx habitat, and will not use such baits within 100 meters of any conifer forest type above 8,000 feet elevation (above sea level).

3. WS personnel will utilize leg-hold traps and foot or leg 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).

4. WS 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)

5. WS personnel will not use M-44 devices or Livestock Protection Collars (LPCs) within 100 meters of any conifer forest type above 8,000 feet elevation (above sea level).

6. WS personnel will remove a tracking dog from trailing a lynx.

7. WS will provide the Service with an annual report detailing implementation of these conservation measures.

Based on the low frequency of lynx occurrence in New Mexico and implementation of the above conservation measures, the USFWS believes the effects of WS activities on the lynx are insignificant and discountable. These conservation measures assure that certain activities will not be conducted within lynx habitat and the USFWS does not anticipate that any lynx will be harmed or harasses as a part of NM WS activities. The USFWS concurs that WS activities may affect by are not likely to adversely affect the lynx.

3.6.4.16 Jaguar

The jaguar is the largest species of cat now native to the Western Hemisphere. Jaguars are large muscular cats with relatively short massive limbs, a deep-chested body, and cinnamon-buff in color with many black spots. Its range in North America includes Mexico and portions of the southwestern United States. A number of recent records (2016) of jaguars are known for southeast Arizona and southwest New Mexico. Records of the jaguars in Arizona and New Mexico have been attributed to the subspecies *P. o. arizonensis*. The historical range of the jaguar included portions of Arizona, New Mexico, and Texas. The current range is from central Mexico through Central America and into South America as far as northern Argentina. In March 1996, the presence of a jaguar was confirmed through photographs made in the Peloncillo Mountains of New Mexico and Arizona (Glenn 1996). Brown (1983) presented an analysis suggesting there was a resident breeding population of jaguars in the southwestern United States at least into the 20th century. USFWS (1990) recognized that the jaguar continues to occur in the American Southwest as an occasional wanderer from Mexico.

The jaguar was listed in 1994, and WS initiated consultation with the USFWS who issued a BO and amendment in 1999 (USFWS 1999a, b). USFWS issued a may affect, not likely to jeopardize finding with RPAs and RPMs. USFWS also issued an incidental take statement in the BO. Direct take for depredating jaguars, though, can only be covered under a separate permit and consultation with USFWS. WS in New Mexico abides by the BO (USFWS 1999 a, b). The BO was reviewed in 2014 and deemed still complete and effective.

On July 22, 2021 the U.S. Fish and Wildlife Service issued this final rule to comply with a court order to vacate Unit 6 and the New Mexico portion of Unit 5 from the March 5, 2014, final rule designating approximately 764,207 acres of land in New Mexico and Arizona as critical habitat for the jaguar (Panthera onca) under the Endangered Species Act of 1973, as amended. This final rule removes approximately 110,438 acres of land within New Mexico from the designation of critical habitat for the jaguar. This ruling removes all jaguar critical habitat in New Mexico. However, Unit 5 critical habitat remains at the Arizona/New Mexico border. For this reason, WS-New Mexico will continue to abide by the conservation measures listed below for all PDM activities near jaguar critical habitat.

WS has agreed to implement the following measures when working near critical habitat for jaguar:

1. All animal damage control activities of this program within occupied range of the jaguar will be conducted in such a manner so as to minimize any risk to the jaguar.

2. All WS cooperators within the occupied range of the jaguar will be informed by WS of the status of the jaguar and the specifics of its protection under the Act.

3. All appropriate permits will be obtained prior to any predator control activities.

4. WS will investigate reports of any and all observations of jaguars or signs of jaguar presence in the general vicinity (50 miles) of any active WS animal control activities which may affect the jaguar, in cooperation with the appropriate State wildlife agency and Jaguar Conservation Team. WS will provide USFWS with a report of such investigations as well as any animal control activities conducted by WS within occupied habitat of the jaguar.

5. All WS employees that may be expected to conduct activities which may affect jaguars will receive adequate training.

3.6.4.17 Mexican long-nosed bat and Lesser long-nosed bat

These federally listed endangered species are found in desert scrub areas of southwestern New Mexico in Hidalgo County and Grant County. The Mexican long-nosed bat is found at medium to high elevations (Hensley and Wilkins 1988) whereas the lesser long-nosed bat is found in canyons and nearby grass and shrub lands near oak woodlands (Findley et al. 1975). Both species roost in caves, mines, abandoned tunnels (Hensley and Wilkins 1988, Hoffmeister 1986), and, potentially, buildings (Hall and Dalquest 1963) by day which are often in rugged terrain and forage at night on the nectar, pollen and fruit of paniculate agaves and columnar cacti. These bats are migratory and are present in New Mexico only from April through September. Disturbance at colonial roost sites, loss of food sources, and direct killing by humans have been identified as key factors in their decline, though the lesser long-nosed bat population is stable to increasing (NMDGF 2012).

The long-nosed bat's diet, nocturnal behavior, and habitat preference preclude them from being inadvertently affected by most WS WDM activities. However, a few individual bats and those migrating could get into places where they might be targeted by WDM. It is possible that one could enter a building where it was targeted with capture by hand or a net and released outdoors or the use of daytime harassment and exclusion to evict a bat or roost from an occupied building. The species of bat would typically be unknown until it was captured. Bats are also captured in disease monitoring projects, specifically targeting bats with mist netting (capture and sample with subsequent release or collection). Finally, nighttime harassment with sound-scare devices is sometimes used at airports to deter wildlife from air operating areas and by livestock owners and their agents to scare predators from a given area. These activities could unintentionally scare bats. However, these species for the most part roost in colonies in caves, mines, and abandoned buildings in rugged terrain where WS would not conduct such activities. If WS were going to target a long-nosed bat or had the potential to take a long-nosed bat during a bat-rabies or other disease monitoring project, the appropriate ESA Section 10 permit would be secured prior to taking action.

New Mexico WS conducted the hand capture of bats in the past 5 FYs (FY15 – FY19), but has not conducted any of the other activities. The hand capture of bats typically involves catching a lone bat by hand or with a net which is entrapped in a home or a building where it represents a concern or disease threat to residents; bats sometimes enter buildings or homes through an open door or window and subsequently are unable to find their way out because it is closed. After capture, they are freed outdoors unless they show signs of injury or disease (i.e., loss of coordination); bats exhibiting odd behavior would be turned over to the Health Department for rabies analysis, especially if direct contact with a person or a pet had occurred. The hand capture of bats, though, would be beneficial for the bat because they could be hurt by concerned residents or their pets, or starve if they could not find a way out such as an open window or door if they entered through such a pathway. None of the bats captured by WS came from Hidalgo County, but the species of bats caught were limited to Mexican free-tailed bats and big brown bats. If WS were requested to capture or evict a bat in a structure in Hidalgo County, WS will notify USFWS. USFWS could send a qualified and permitted USFWS biologist to remove the bat for relocation outdoors or permit WS personnel to take a similar action.

WS in New Mexico could use exclusion and harassment (i.e., daytime lights in an attic) to evict and exclude bats from roosting in buildings. Public health concerns associated with rabies and other zoonotic diseases are the concerns typically associated with these damage requests. WS uses these techniques when a maternal colony is not expected to be present (August-April). However, WS has not provided this technique for bats in New Mexico in the last 5 FYs (FY15 – FY19). If this were conducted in New Mexico in Hidalgo County, WS would contact USFWS for a permit, unless the species of bat was known and not a lesser or Mexican long-nosed bat. In most situations, exclusion devices are installed after the bats migrate out of New Mexico from November through March, unless an emergency exists (i.e., human health and safety concern).

Mist nets were last used in New Mexico in FY07 to capture shorebirds for disease monitoring. These were not used nocturnally, so the likelihood of encountering a Mexican long-nosed bat was highly unlikely, as they are highly specific, nocturnal feeders. Therefore, WS concludes that it would not take either of these species of bats if this method was used properly, during daytime hours. Additionally, the mist nets were not used in Hidalgo County. Mist nets have been used by Arizona WS along with other agencies in the Chiricahua Mountains of southeastern Arizona to capture bats for an enhanced rabies surveillance project with the appropriate permit from USFWS. Outside of deliberately targeting bats, mist nets in WDM are used mostly in urban bird damage management situations, especially in buildings where birds are entrapped (i.e., house sparrows in a mall), and for disease sampling and monitoring, primarily for shorebirds or other small birds. Outdoor use by WS nationwide is rare and is most typically associated with disease monitoring and banding for research projects. Even so, mist nets are monitored at least hourly during use outdoors and taken down by nightfall for diurnal birds. While these could be used at night for bats and species such as owls, it would be only after an appropriate permit from USFWS had been acquired when used in Hidalgo County. WS currently does not anticipate any requests to use mist nets in Hidalgo County and, therefore, concludes no effect with this method.

Finally, nighttime harassment of wildlife with pyrotechnics and other sound-scare devices can sometimes be conducted to scare predators from livestock bedding grounds or wildlife from airports. This activity could inadvertently harass bats. However, WS has not conducted such activities in Hidalgo County where these species occur in the last 5 FYs (FY15 – FY19) and does not have any airport programs in Hidalgo county. Since WS has not conducted this activity in Hidalgo County, this WDM method currently has no effect on these 2 bat species. If WS does initiate a nighttime harassment program (which would likely be for a wandering Mexican wolf that has predated livestock) it could displace bats temporarily, however this is not a long term or continuous action. Thus, this method may affect, but is not likely to adversely affect these two species of bats because the effects would be insignificant. WS personnel will discuss any PDM projects with USFWS prior to conducting these activities in their critical habitat

3.6.4.18 New Mexico meadow jumping mouse

The jumping mouse nests in dry soils, but resides in moist, dense riparian areas along perennial streams composed of willow and alders (Alnus spp.) or wetland vegetation with persistent emergent herbaceous layer of sedges and reeds. They occupy areas up to 8,000 feet in Arizona, New Mexico, and Colorado. The jumping mouse hibernates about 9 months out of the year which is longer than most other mammals. Their range includes the Rio Grande corridor in central New Mexico, all the way up to southern Colorado and some eastern counties on the Arizona-New Mexico border. Identified threats to this subspecies include excessive grazing pressure, water use and management, highway construction, development, recreation, and beaver removal. The highly fragmented nature of its distribution is also a major contributor to the vulnerability of this species and increases the likelihood of very small, isolated populations being extirpated. The insufficient number of secure populations throughout its range and the destruction, modification, and curtailment of its habitat continue to pose the most immediate threats to this species.

WS-New Mexico's PDM activities may affect but not likely adversely affect this because WS avoids conducting PDM activities in areas where the jumping mouse is known to occur and does not conduct PDM activities in or near water sources (USFWS 2014). WS personnel will discuss any PDM projects with USFWS prior to conducting these activities in their critical habitat.

3.6.4.19 Piping plover

The piping plover breeds in north-central and eastern United States and up into Canada. Piping plovers winter along the Gulf Coast and further south, primarily on coastal beaches. These plovers are very rare transient spring, and potentially fall, migrants through New Mexico (NMDGF 2012). It is listed in only Colfax and Socorro Counties, though it likely could appear anywhere in the State during migration. They prefer lake and river mudflats, sandy beaches, and sandbars; WDM is typically not associated with these areas. Disease monitoring has a minimal potential to capture a piping plover with the use of mist nets or noose mats (noose mats have not been used by New Mexico WS). WS has agreed in a separate informal consultation that WS will monitor an area for piping plovers prior to using mist nets and noose mats and would take down all mist nets and cover noose mats if a piping plover were seen in an area to nullify the potential to take this species. In addition, these tools are designed for live capture and release, so even if a piping plover was inadvertently taken during these activities, it is expected that the bird would be released without lasting injury. Thus, it was determined that WS would have no effect on the piping plover conducting disease surveillance. The USFWS concurred with WS that WDM activities in New Mexico may affect but is not likely to adversely affect the piping plover.

3.6.4.19 Least tern (interior population)

This small endangered tern species is known from scattered locations in New Mexico along the Rio Grande corridor, being primarily seen near bodies of water. It has been known to breed in southeast New Mexico in Chaves County at Bitter Lake National Wildlife Refuge, on the Pecos River (NMDGF 2012). It nests on sandbars and feeds on small fish, insects, and crustaceans. This tern's aquatic feeding habits preclude it from exposure to PDM activities. If predators such as skunks, foxes, raccoons, or coyotes were hampering the recruitment of a nesting colony of least terns, WS could conduct PDM to benefit the terns. If WS was contracted to conduct work PDM where predation was a limiting factor, WS would consult further with USFWS prior to undertaking such an activity. NMDGF or USFWS would likely be the agency requesting such an action. Thus, USFWS or NMDGF would likely obtain a permit to conduct such activity. WS concluded and the USFWS concurred that WDM activities in New Mexico may affect but are not likely to adversely affect the interior population of least terns because the effects would be insignificant or beneficial.

3.6.4.20 Yellow-billed cuckoo

The western DPS of the yellow-billed cuckoo is rare throughout western New Mexico. It is found in 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 invertebrates such as caterpillars, but it may also take small vertebrates. Their nests are primarily found in nearby willows. They typically arrive on their breeding grounds from late April to early May and leave from late August to early October (Hughes 1999). 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 conducts minimal PDM activities in the habitat where this species is found. The USFWS concurred that WS may affect but is not likely to adversely affect the cuckoo because this potential would be minimal and likely be very temporary.

3.6.4.21 Mexican spotted owl

The Mexican spotted owl lives in mixed-conifer old-growth forests in mountainous areas and heavily forested canyons throughout western New Mexico where they feed on small rodents. The logging of old-growth forests and forest fragmentation has been considered primary factors in their decline (NMDGF 2012). The primary predator control method that has a chance of taking a nontarget owl would be a leghold trap. However, the implementation of pan tension devices on traps greatly lowers the chance of catching non-target species such as birds, and PDM activities rarely take place in densely forested tracts of land. Since 2004, only one owl was inadvertently captured by NM WS. A Great horned owl was captured and released from a neck snare in 2008. Predator damage management using traps, snares, or shooting, both ground and aerial, conducted within spotted owl habitat could potentially disturb owls, but the possibility is very remote since these activities are conducted only short term and the owls are fairly tolerant of minor human activity. WS consults with USFS staff regarding the location of Mexican Spotted Owl Primary Activity Centers (PAC's) and tries to minimize ground activities in those areas in order to minimize disturbance during nesting season. In addition, WS does not conduct aerial shooting within 0.25 mile of active Mexican spotted owl nest sites in order to minimize disturbance. WS concludes and the USFWS concurs that WDM may affect but is not likely to adversely affect this species because impacts would be negligible. WS consults with USFWS further when WDM activities are planned in occupied, proposed, and designated critical habitat, other than just walking through these areas or surveying areas for sign of particular wildlife.

3.6.4.22 Southwestern willow flycatcher

The southwestern willow flycatcher occurs in riparian habitats with dense vegetation such as willows (*Salix* spp.), tamarisk (*Tamarix* spp.), or Russian olives (*Elaeagnus angustifolia*) (NMDGF 2012). It is found in New Mexico from mid-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) (Sedgwick 2000, USFWS 2002d).

WS WDM methods that have the potential for affecting the flycatcher are primarily related to aquatic rodent damage management and bird damage management activities. The presence of WS personnel near nesting sites could potentially disturb nesting birds. However, WS personnel do not remain in any area for long periods and move on shortly after conducting PDM activities. WS believes that such brief encounters will have no effect on this species.

Considering the flycatcher's habitat preference (riparian area with dense growth), seasonal presence (summer *vs.* winter), and diet (insectivorous), it is very unlikely that this species would be affected by any WDM method as used by WS in New Mexico. The USFWS has concurred that WDM may affect but is not likely to adversely affect the southwestern willow flycatcher because the effects would be insignificant.

3.6.4.23 Lesser Prairie-chicken

This species of grouse is endemic to the southern high plains of the US, known for its elaborate breeding behavior. The prairie-chicken favors the sand sage (*Artemisia filifolia*), bluestem (Andropogon spp.) grasslands in southeastern Colorado, eastern New Mexico and the panhandles of Texas and Oklahoma, in New Mexico preferring the fairly open grassland and sagebrush upper desert habitat. Declines in this species area a result of habitat loss/habitat fragmentation in addition to habitat destruction and/or alteration, but predation and disease (specifically West Nile virus) also play a role in their decline. Disruption at leks, sites where grouse congregate during the breeding season, has also been a concern. Leks are located in gently sloping or flat areas located on bare soil, wind-swept ridges, exposed knolls, low brush, meadows, and other relatively open sites with good visibility and low vegetation structure, which makes them susceptible to disruption by oil and gas traffic in the open prairie, or provides predator posts for raptors through the presence of power lines.
WS PDM do have the potential to take a prairie-chicken with smaller leghold traps, larger cage traps, rodenticides, and aerial hunting, but smaller leghold traps are rarely used by WS-NM. These traps are more often used to capture smaller predators in less rural areas where they are causing damage, and WS-NM will only be used in areas where prairie-chickens would not have access to them. Larger cage traps will be monitored daily when used in grouse habitat and any grouse caught will be released. From FY92 to FY19 WS-NM has never unintentionally taken a prairie-chicken. Rodenticides used for prairie dogs and ground squirrels could be a hazard for grouse, however coloration of these products minimizes the likelihood for a grouse to take the bait. In addition, applicators are required to place these baits in active burrows, bait boxes, or other structures which minimizes the potential for prairie-chicken to take the bait.

The USFWS has concurred that WDM may affect but is not likely to adversely affect lesser prairie-chicken because the effects would be insignificant or have a beneficial effect.

3.6.5 What are the comparative impacts of the alternatives on T&E species?

3.6.5.1 Alternative 1 comparative impacts on T&E species

Impacts on all state- and federally-listed T&E species from WS-New Mexico PDM activities are negligible. Since at least FY 2004, WS-New Mexico has taken just one state or federally-listed T&E individual while conducting PDM activities. WS-NM has not taken any T&E species from FY15 to FY19. WS developed SOP's that limit risky circumstances including shooting distance and night hunting, to avoid inadvertent take of a Mexican wolf. WS-New Mexico follows all reasonable and prudent measures and terms and conditions required in the December 16, 2014 concurrence letter from USFWS (Sections 2.4.1.17, 2.4.2.1, 2.4.2.2, WS Directive 2.310). In the concurrence letter, USFWS determined that the actions as proposed by WS-New Mexico are not likely to jeopardize gray wolf populations. Additionally, USFWS has concurred with WS-New Mexico's determination that all other plant and animal species that may be affected by PDM are not likely to be adversely affected or are not likely to be jeopardized based on the protective measures documented in the informal consultations and Sections 2.4.2.1 and 2.4.2.2, and WS Directive 2.310 (Section 2.4.1.17). WS-New Mexico would continue to adhere to or update all Section 7 consultations as required by the ESA.

3.6.5.2 Alternative 2 comparative impacts on T&E species

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities as described in Section 3.4, with reported take incorporated into the cumulative impact analysis, as in Alternative 1.

With this alternative, WS-New Mexico 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 (as discussed in Section 3.4). 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 training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-New Mexico employees. WCO may not have the experience or response capability with some of the species and methods if they are not already conducting DPM activities for those particular species (Section 3.4.2).

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. Depending on the readiness and interest of other entities to conduct PDM activities, the cumulative number of predator removals could be greater than, less than, or similar to the cumulative take under Alternative 1. It is possible that more T&E species could be incidentally taken by other entities, as a result of less selective predator removals and lack of protective measures to minimize take of T&E species. Non-federal entities do not complete ESA Section 7 consultations, and it would be difficult to determine what, if any, protective measures were in place by individual landowners to minimize the take of T&E species.

Additionally, T&E species would not benefit from lethal PDM conducted by WS-New Mexico for T&E species protection. Other entities may not be trained to identify T&E species and their habitats or be able to conduct lethal PDM activities to protect T&E species from predation, unless authorized by USFWS.

WS-New Mexico has not taken any T&E species between 2015 and 2019, any increase in take of a T&E species by other entities would have equal or greater adverse effects on T&E species populations compared to the potential adverse effects under Alternative 1.

3.6.5.3 Alternative 3 comparative impacts on T&E species

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. Lethal methods applied by WS-New Mexico would have similar impacts on T&E species as those analyzed under Alternative 1. Non-lethal methods implemented by WS-New Mexico would not adversely affect T&E species (USFWS 2014). The APHIS-WS Decision Model may not be fully effective because if they are deemed necessary, lethal actions could not be used by WS-New Mexico 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 as described in Section 3.4.

During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners could use trained and experienced WCOs or may implement lethal methods themselves. However, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Non-federal entities do not complete ESA Section 7 consultations, and it would be difficult to determine what, if any, protective measures were in place by individual landowners to minimize the take of T&E species. Other entities may not be trained to identify T&E species and their habitats or be able to conduct lethal PDM activities to protect T&E species from predation, unless authorized by USFWS.

WS-New Mexico has not taken any T&E species between 2015 and 2019, any increase in take of a T&E species by other entities would have equal or greater adverse effects on T&E species populations compared to the potential adverse effects under Alternative 1.

3.6.5.4 Alternative 4 comparative impacts on T&E species

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. When WS-New Mexico responds with lethal control of predator species under the limited circumstances allowable under this alternative, the impacts on T&E species from WS-New Mexico would be less than those described for Alternatives 1 and 3, since fewer predators are removed under this alternative. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities as described in Section 3.4.

WS-New Mexico would not be able to respond with lethal methods to damage or threats to any other resources or situations. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Non-federal entities do not complete ESA Section 7 consultations, and it would be difficult to determine what, if any, protective measures were in place by individual landowners to minimize the take of T&E species. Other entities may not be trained to identify T&E species and their habitats or be able to conduct lethal PDM activities to protect T&E species from predation, unless authorized by USFWS.

WS-New Mexico has not taken any T&E species between 2015 and 2019, any increase in take of a T&E species by other entities would have equal or greater adverse effects on T&E species populations compared to the potential adverse effects under Alternative 1

3.6.5.5 Alternative 5 comparative impacts on T&E species

WS-New Mexico would have no effect on T&E species under this alternative. T&E species would not benefit from PDM conducted by WS-New Mexico for T&E species protection. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Non-federal entities do not complete ESA Section 7 consultations, and it would be difficult to determine what, if any, protective measures were in place by individual landowners to minimize the take of T&E species. Additionally, T&E species would not benefit from the PDM conducted by WS-New Mexico for T&E species protection. Other entities may not be trained to identify T&E species and their habitats or be able to conduct lethal PDM activities to protect T&E species from predation, unless authorized by USFWS.

WS-New Mexico has not taken any T&E species between 2015 and 2019, an increase in take of a T&E species by other entities would have equal or greater adverse effects on T&E species populations compared to the potential adverse effects under Alternative 1.

Furthermore, other entities may not be able to conduct lethal PDM activities to protect T&E species from predation, unless authorized by USFWS.

3.7 IMPACTS ONOTHER NON-TARGET SPECIES

Between FY 2015 and 2019, WS-New Mexico unintentionally killed an average of 77.4 animals per year while conducting PDM. An additional 38.4 animals were captured and freed per year, on average (Table 3.18). The total unintentional lethal take during these years was just 1.23% of the total PDM lethal take indicating that the methods and procedures used are highly selective for target species. A large proportion of the animals that were killed were gray fox, badgers, kit fox, and swift fox, captured mostly in neck snares or taken with M-44's.

Following is an account of the average number of animals of each species that WS-New Mexico unintentionally took during PDM activities each year during the reporting period from FY 2015 through 2019. The capture methods and the percentage of take compared to intentional take is summarized.

Raccoon. WS-New Mexico unintentionally lethally removed an average of 2 raccoons per year. These animals were captured in foothold traps, neck snares, and cage traps, and euthanized. An average of less than 1 per year were captured in foothold traps, neck snares, and cage traps, and were freed.

Kit Fox. WS-New Mexico unintentionally lethally removed 8 kit fox per year with foothold traps, neck snares, and M-44's. Only one was caught unintentionally and released from foothold traps over the five years.

Gray Fox. An average of 21.4 gray fox per year were unintentionally captured or killed in foothold traps, neck snares, and with M-44's by WS-New Mexico during the five year period. And an average of 3.4 per year were freed primarily from foothold traps.

Red Fox. Two red fox were unintentionally taken and killed, 1 in a neck snare and another on an M-44, by WS-New Mexico during the five-year period.

Swift Fox. WS-New Mexico unintentionally lethally removed an average of 8 swift fox yearly with M-44's, foothold traps, and neck snares. 1.2 per year were captured and released.

Badger. WS-New Mexico unintentionally captured and euthanized an average of 9 badgers per year with foothold traps and neck snares. 5.4 badgers per year on average were caught in a leg-hold traps or snares and released.

Bobcat. WS-New Mexico unintentionally captured and euthanized 1.4 bobcats per year in neck snares, and freed 1.6 per year from foothold traps and neck snares during the five years.

Feral/Free-ranging Dog. WS-New Mexico unintentionally captured and killed an average of 5.4 feral/free-ranging dogs during the five-year period primarily with M-44's and neck snares. Another 2.6 were captured in foothold traps or neck snares and released annually.

Mexican gray wolf. No Mexican gray wolves were taken unintentionally by WS-NM between FY15 and FY19.

Pet/Livestock

Striped Skunk. An average of 6 striped skunks per year were unintentionally lethally taken in foothold traps, neck snares, and M-44's.

Hog-nosed Skunk. WS-New Mexico unintentionally captured and euthanized less than 1 hog-nosed skunk per year during the five year period. All were in foothold traps.

Porcupine. An average of 6.4 porcupines per year were unintentionally captured in neck snares and foothold traps and euthanized by WS-New Mexico. Even though porcupines are very difficult to release, WS-New Mexico freed an average of 2.2 per year from foothold traps and neck snares.

Mule Deer. WS-Mew Mexico unintentionally captured and killed an average of 1.6 mule deer per year in neck snares. An additional 0.4 per year on average were released from foothold traps.

Golden Eagle. One golden eagle was unintentionally captured and killed in a neck snare during the five-year period.

Black-tailed Jackrabbit. An average of 5.2 black-tailed jackrabbits were unintentionally captured, primarily in neck snares, and euthanized by WS-New Mexico.

Ringtail, One ringtail was captured and released during the five-year period.

Northern Harrier. One nontarget northern harrier was captured in a foothold trap and euthanized during the five-year period.

Desert Cottontail. 1 desert cottontail was unintentionally captured and released in foothold traps.

Feral/Free-ranging Cat. No cats were unintentionally captured and killed. WS-New Mexico unintentionally captured 7 cats per year primarily in cage traps with a few in in a foothold traps and neck snares. All were released.

3.7.1 What are the comparative impacts of the alternatives on populations of animals taken unintentionally?

3.7.1.1 Alternative 1 comparative impacts on populations of animals taken unintentionally

WS-New Mexico unintentionally takes an average of 77.4 animals, with an additional 38.4 animals captured and freed (Table 3.18). Under the Proposed Action, WS-New Mexico would be expected to continue to have a similar minimal level of unintentional take each year. WS-New Mexico would continue to use the same protective measures outlined in this EA (Section 2.4). Unintentional predator take was evaluated in Section 3.5 as part of the cumulative effects analysis. Non-predator unintentional take is so low as to be negligible, especially because those species unintentionally taken are abundant in New Mexico.

WS-New Mexico's PDM activities are highly selective for predatory animals, and as shown in Sections 3.7 and 3.5, unintentional take is expected to remain negligible.

3.7.1.2 Alternative 2 comparative impacts on populations of animals taken unintentionally

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners would be expected to continue to conduct PDM activities as described in Section 3.4. WS-New Mexico would anticipate having close to no unintentional take under this alternative, however there is always a minimal potential for unintentional take when using non-lethal methods.

With this alternative, WS-New Mexico 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 (as discussed in Section 3.4). 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 training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-New Mexico employees. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting DPM activities for those particular species (Section 3.4.2).

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Depending on the skillset of others in minimizing unintentional captures, the number of animals unintentionally killed could be greater than, less than, or similar to the unintentional take under Alternative 1. It is possible that more animals could be taken unintentionally by other entities, as a result of less selective removals effort. Conversely, fewer animals may be unintentionally removed in the absence of lethal operational assistance from WS-New Mexico because there may be fewer entities readily available to help address conflicts, and because individuals experiencing damage may not take action themselves.

Although it is not possible to determine how many additional animals would be taken unintentionally by non-WS-New Mexico entities, it is assumed that WCOs would take few animals unintentionally, similar to that of WS-New Mexico. However, landowners or private entities may unintentionally take more animals than WS-New Mexico or WCOs would due to having less proficiency in the range of methods and being less selective with their use. In addition, many of the protective measures used by WS to minimize adverse effects (Section 2.4) may not be implemented by private individuals. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1.

Therefore, there is a potential for higher levels of unintentional take by other entities, compared to Alternative 1. However, because the predator and non-predator species are generally resilient and below the current annual maximum sustainable harvest level (Section 3.5), the populations of unintentionally taken animals are expected to remain stable.

3.7.1.3 Alternative 3 comparative impacts on populations of animals taken unintentionally

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. WS-New Mexico would likely take slightly fewer individuals compared to Alternative 1. Non-lethal methods would not likely contribute to an unintentional lethal effect on animals. The APHIS-WS Decision Model may not be fully effective because if they are deemed necessary, lethal actions could not be used by WS-New Mexico 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 as described in Section 3.4.

If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners 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-New Mexico.

However, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. 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-New Mexico employees, increasing the risk of unintentionally taking animals.

Therefore, there is a potential for higher levels of unintentional take by other entities, compared to Alternative 1. However, because the predator and non-predator species are generally resilient and below the current annual maximum sustainable harvest level (Section 3.5), the populations of unintentionally taken animals are expected to remain stable.

3.7.1.4 Alternative 4 comparative impacts on populations of animals taken unintentionally

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. Because operational lethal actions would be limited and not available to manage damage to other resources, WS-New Mexico would likely take fewer predators than under Alternative 1, and thus there would be less potential for unintentionally take. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities as described in Section 3.4.

However, WS-New Mexico would not be able to respond with lethal methods to damage or threats to any other resources or situations. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. 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-New Mexico employees, increasing the risk of unintentionally taking animals.

Therefore, there is a potential for higher levels of unintentional take by other entities, compared to Alternatives 1 and 3. However, because the predator and non-predator species are generally resilient and below the current annual maximum sustainable harvest level (Section 3.5), the populations of unintentionally taken animals are expected to remain stable.

3.7.1.5 Alternative 5 comparative impacts on populations of animals taken unintentionally

WS-New Mexico would have no unintentional take of individual animals under this alternative. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. 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-New Mexico employees, increasing the risk of unintentionally taking animals.

Therefore, there is a potential for higher levels of unintentional take by other entities, compared to Alternatives 1-4. However, because the predator and non-predator species are generally resilient and below the current annual maximum sustainable harvest level (Section 3.5), the populations of unintentionally taken animals are expected to remain stable.

Table 3.18. Animals Unintentionally Captured during WS-New Mexico PDM Activities by Method FY 2015- FY 2019.

Species	M-44	Foot Snares	Neck Snares	Cage Traps	Foothold Traps	5 Year Average
Unintentional take - Killed						
Badgers			24		21	**9**
Bobcats		2	4		1	**1.4**
Coyotes					1	**0.2**
Deer, Mule			8	0		**1.6**
Dogs, Feral, Free-Ranging And Hybrids	18	1	8		0	**5.4**
Foxes, Gray	84		18	0	5	**21.4**
Foxes, Kit	32		8		0	**8**
Foxes, Red	2					**0.4**
Foxes, Swift	22		5		13	**8**
Hares, Jackrabbits, Black-Tailed			26			**5.2**
Hawks, Harrier, Northern (Marsh Hawks)					1	**0.2**
Lions, Mountain (Cougar)			1		1	**0.4**
Peccaries, Collared (Javelina)			1	0	1	**0.4**
Porcupines			32			**6.4**
Pronghorns (Antelope)			2			**0.4**
Raccoons			0	2	8	**2**
Ravens, Common	2					**0.4**
Skunks, Hog-Nosed					3	**0.6**
Skunks, Striped	2		3		25	**6**
Average Take per year	**32.4**	**0.6**	**28**	**0.4**	**16**	**77.4**

Species	Foot snares	Neck snares	Cage traps	Corral traps	Foothold traps	5-Year Average
Unintentional Take - Freed						
Badgers		14			13	5.4
Bears, Black	3					0.6
Bobcats	0	1			7	1.6
Cats, Feral/Free Ranging			35			7
Cattle, Domestic		2				0.4
Deer, Mule		1	1			0.4
Dogs, Feral, Free-Ranging And Hybrids	3	7			3	2.6

Domestic Animal (Pet Or Livestock)		2				0.4
Doves, Mourning			9			1.8
Doves, White-Winged			21			4.2
Elk, Wapiti (Captive)				1		0.2
Elk, Wapiti (Wild)	1					0.2
Foxes, Gray		0	0		17	3.4
Foxes, Kit		0			1	0.2
Foxes, Swift		0			6	1.2
Peccaries, Collared (Javelina)		0	28		0	5.6
Porcupines		11				2.2
Rabbits, Cottontails, Desert			1			0.2
Raccoons		1	0		2	0.6
Ringtails			1			0.2
Average Take Per Year	**1.4**	**7.8**	**19.2**	**0.2**	**9.8**	**38.4**

[1] No predators were captured and killed unintentionally during WS-New Mexico non-PDM activities.
[2] Unintentional take of other non-predator species during WS-New Mexico IWDM (compared to PDM) activities were taken during aquatic mammal and bird activities, which uses different methods and sets (bodygrip sets for aquatic mammals are set in water, not on land like used for predators).
[3] These individual animals were taken during WS-New Mexico PDM activities.
WS-New Mexico

3.8 WHAT IS THE POTENTIAL FOR WS-NEW MEXICO PDM ACTIVITIES TO RESULT IN TROPHIC CASCADES?

3.8.1 Introduction

• Trophic cascades are indirect species interactions that originate with predators and spread downward through food webs (Ripple et al. 2016). In a simple example, predators, their herbivore prey, and plants that provide food for herbivores are three trophic levels that interact in a food web. Some members of the public are concerned that APHIS-WS' activities which remove top (or apex) predators will create the conditions for trophic cascade by reducing the predation pressure on lower tropic levels, including plant communities. Apex predators can be defined as species that feed at or near the top of the food web of their supporting ecosystem and that are relatively free from predation themselves once they reach their adult size (Sergio et al. 2014), such as bears, coyotes, and cougars in New Mexico. The concern is that species in lower trophic levels could then take on new ecosystem roles, possibly having negative effects on other species and habitats (Appendix E5). Concerns have been focused primarily on the potential for trophic cascades to occur due to predator removals to protect livestock. For example, decreasing apex predators could reduce pressure on herbivore populations, which in turn overexploit vegetation and effect water quality.

WS-New Mexico does not dispute the significance of the ecological role played by predators. APHIS-WS shares concerns with the public and scientific community for the integrity of ecological systems in which we live, work, and recreate. APHIS-WS utilizes measures to protect ecosystem integrity and minimize adverse effects of PDM by focusing PDM on specific individuals or localized groups (Sections 1.12.3 & 2.4).

Our analysis, however, indicates that the PDM activities evaluated in this EA are not expected to cause trophic cascades. This section will discuss why WS-New Mexico PDM activities do not affect predator populations in New Mexico and therefore are unlikely to create trophic cascades.

APHIS-WS has reviewed public comments and the concerns of some authors that its activities might disrupt ecosystems and cause trophic cascades by eliminating or substantially reducing top predators (Bergstrom et al. 2014). Consequently, we reviewed pertinent scientific literature on the subject to consider as part of the analysis of this issue (e.g., Ballard et al. 1997, Stenseth et al. 1997, Halah and Wise 2001, Wilmers et al. 2003, Schmitz et al. 2004, Hebblewhite et al. 2005, Ripple and Beschta 2006, 2008, 2010, Berger et al. 2008, Kauffman et al. 2010, Brown and Conover 2011, Estes et al. 2011, Ripple et al. 2011, Beschta and Ripple 2012, Levi and Wilmers 2012, Squires et al. 2012, Callan et al. 2013, Marshall et al. 2013, Sergio et al. 2014, Painter et al. 2015, Ripple et al. 2015, 2016, Benson et al. 2017, Engeman et al. 2017, Allen et al. 2017).

A summary of relevant scientific publications on trophic cascade research and related topics is in Appendix E. The results of the literature review, combined with the analyses of potential direct and cumulative impacts to populations of predator species (Section 3.5), provides the basis for WS-New Mexico's conclusion that PDM activities are highly unlikely to cause trophic cascades in New Mexico.

3.8.2 What are the relevant scientific concepts and studies for understanding trophic cascades?

- The science associated with the study of trophic cascades is relatively new, and is based primarily on freshwater aquatic, marine intertidal, and terrestrial grassland and crop-dominated ecosystems. Only recently has trophic cascade research been focused on understanding coyote and wolf responses to predator control (e.g., Berger and Gese 2007, Ripple et al. 2013). Studies suggest that different ecosystems respond dissimilarly to changes in apex predator populations for many reasons, including the inherent variability and different levels of productivity of terrestrial, aquatic, and marine ecosystems; the number of ecological interactions and interrelationships among predators and prey within a food web; the ability of animals to move into and out of a particular area (an open system), which affects to the food web are being studied; whether a predator may also eat plants; and whether a predator may eat individuals of another predator species, such as coyotes eating foxes within a trophic food web (e.g., Pace 1999, Borer et al. 2005, Vance-Chalcraft et al. 2007, Ripple et al. 2016).
- The study of trophic cascades is complex, and includes the following concepts:
    - **Intraguild predation** (IGP), which broadened the trophic relationships from vertical chains sometimes involving shared prey, to include horizontal relationships where predators kill and sometimes eat other predators in what became known as a food web rather than a food chain (Appendix E.8.1; e.g., Polis et al. 1989, Palomares 1995, Litvaitis and Villafuerte 1996, Palomares et al. 1996, Arim and Marquet 2004, Finke and Denno 2005, Berger and Gese 2007, Daughterty et al. 2007);

- **Mesopredator release** (MPR), a concept in which the suppression or removal of historical top predators may release populations of smaller predators, such as foxes, raccoons, or often coyotes, which may have different impacts on the ecosystem (Appendix E 8.2; e.g., Crooks and Soulé 1999, Prugh et al. 2009, Ritchie and Johnson 2009, Roemer et al. 2009, Brashares et al. 2010, Ripple et al. 2013, Allen et al. 2014, Allen et al. 2018);
- **Adaptive behavior** of individuals or groups of prey species to reduce the risk of predation, such as changing habitat use, social structure, and time of certain activities (Appendix E.9.1; e.g., Gese 1996, Gese et al. 1996, Gese 1998, Gese 1999, Kitchen et al. 2000, Schmitz et al. 2004, Peckarsky et al. 2008, Berger-Tal et al. 2010, Wallach et al. 2009, Wilson et al. 2010);
- **Resource partitioning**, wherein predators and prey avoid each other by using different portions of the same habitat, often due to **competitive exclusion** when two species have similar diets or habitats, causing one species to interfere with the ability of the other to use those resources (Appendix E.9.2; e.g., Polis et al. 1989, Arjo et al. 2002, Wilmers et al. 2003, Finke and Denno 2005, Atwood et al. 2008, Gehrt and Prange 2006, Brook et al. 2012, Lendrum et al. 2014);
- **Ecosystem resilience**, the ability of ecosystems to rebound to previous conditions after a major impact or disruption, such as from a wildfire, major weather even, removal of a species, or introduction of an invasive species (Appendix E.11; Hooper et al. 2005, Srivastara and Vellend 2005, Balvanera et al. 2006, Casula et al. 2006, Duffy et al. 2007, Cleland 2011, Ritchie et al. 2012);
- **Ecosystem services**, wherein ecosystems provide sustainable ecological services to humans, such as food, crop pollination, clean water, and clean air (Appendix E.11; e.g., Duffy 2003, Hooper 2005, Srivastara and Vellend 2005, Balvanera et al. 2006, Dobson et al. 2006, Duffy et al. 2007, Cleland 2011).

Most of the literature is not highly applicable to understanding trophic cascades and contributing processes as they relate to large terrestrial predators because of differences in ecosystems (Appendix E.1.23.1), challenges to conducting and interpreting research of complex and dynamic ecological systems (Appendix E.1.23.2), or serious discrepancies in the study design or conclusions (Appendix E.1.24). Researchers have questioned the capability of these studies to be scaled up to larger-scale ecosystems and more complex ecological trophic structures (Borer et al. 2005, Ray et al. 2005, Ripple and Beschta 2006, Vance-Chalcraft et al. 2007, Engeman et al. 2017). Additionally, what we understand in about these complex systems is changing and improving. Mech (2012) stated, "science is self-correcting" remarking that researchers review or build upon others research has the advantage of scrutinizing and improve upon the work of their predecessors. .

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, Engeman et al. 2017). Therefore, many studies rely on areas in which large apex predators were extirpated and either were 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). However, to the extent that these areas can be used to research these complex systems, national parks comprise a small portion of the ecosystem, and that if those ecological effects are found, they don't necessarily apply everywhere else (Muhly 2010, Mech 2012).

Many apex predator species have experienced dramatic range contractions. Their eradication is believed to have trophic impacts on the ecosystems in which they occur, especially through the phenomenon of mesopredator release (Crooks and Soulé 1999, Prugh et al. 2009, Roemer 2009, Brashares et al. 2010, Miller et al. 2012). The presence of predators causes reductions in the prey population or cause the prey population to alter its habitat use. In turn, changes in prey behaviors impact plant community composition and health (Terbough et al. 2001, Ripple and Beschta 2011, Beschta and Ripple 2012). Depending on the nature of the impact and the prey species, changes in vegetation and prey behavior can have impacts on abiotic factors such as soil compaction, soil nutrients, and river morphology (Naiman and Rogers 1997, Beschta and Ripple 2006). In the Midwest, changes in coyote activity impacted white-tailed deer activity, with associated impacts to plant communities (Waser et al. 2014).

However, as with most ecosystems, the nature and magnitude of these types of relationships varies. For example, Maron and Pearson (2011) did not detect evidence that the presence of vertebrate predators fundamentally affected primary production or seed survival in a grassland ecosystem. Similarly, Kauffman et al. (2010) found that predation risk on herbivores alone is unlikely to alter the survivorship of plant communities, but predation in combination with site productivity and abiotic factors, such as soil moisture, mineral content, or snow accumulation, may allow for landscape-level recovery of vegetation.

3.8.3 What is the risk that WS-New Mexico PDM activities may result in trophic cascades?

Most evaluations of the impacts of predator removal or loss on biodiversity involve complete removal over the course of years (e.g., Ripple and Beschta 2006, Berger et al. 2008, Ripple et al. 2016). APHIS-WS does not strive to eliminate or remove native predators from any area on a long-term basis. When direct management of depredating animals is deemed legal, necessary, and desirable, efforts focus on management of the specific depredating animal or local group of animals. Consequently, no predators or prey would be extirpated and none would be introduced into an ecosystem.

APHIS-WS operates on relatively small portions of properties, over relatively short periods, and in accordance with federal and state laws and regulations. APHIS-WS impacts are generally temporary due to natural immigration and reproduction of predators. Additionally, take of predator species are in relatively small or isolated geographic areas in comparison with the overall population. APHIS-WS only conducts activities when and where it is permitted, needed, and requested by cooperators or the public. Since APHIS-WS' actions do not result in long-term extirpation or eradication of any native wildlife species, the findings of most of these studies are not relevant.

Some studies indicate that the conditions necessary for a trophic cascade may require the drastic reduction or complete collapse of apex predator populations (e.g., Ripple et al. 2011, Brashares et al. 2010, Beschta and Ripple 2012). WS-New Mexico works closely with state and federal wildlife managers and land owners to assure that cumulative take of native target and nontarget species is managed at levels that would not have significant impacts on wildlife populations, including those of apex predators. Current APHIS-WS activities do not result in the direct or indirect loss of any wildlife species population or sustained reduction in predator population densities.

WS-New Mexico's take of potential apex predator species (i.e., bears, coyotes, and cougars) is small compared with broader populations of those species. The cumulative take of bears, coyotes, and cougars in New Mexico, respectively, (Section 3.5, Tables 3.3, 3.4, and 3.7) is substantially below that of the annual maximum sustainable harvest level for each species. WS-

New Mexico's take for each species is a lower proportion of the cumulative take than all non-WS take sources reported to NMDGF.
Since WS-New Mexico does not have significant effects on target and nontarget species populations (Sections 3.5 to 3.7), there is no potential for the elimination of apex predators or other native species, and the conditions to precipitate a trophic cascade are not produced. The limited nature of WS take of predator species is so low that substantive long-term shifts in population age structure do not generally occur (Section 3.5). NMDGF has reported that bear, coyote, and cougar populations (as well as other native predators) are stable in New Mexico (Stewart Liley, NMDGF, pers. comm. 8/15/2018).

3.8.4 What are the comparative impacts of the alternatives on ecological trophic cascades?

3.8.4.1 Alternative 1 comparative impacts on ecological trophic cascades

APHIS-WS continues to acknowledge the important ecological role played by predators. However, due to the targeted nature of predator removals (Sections 2.3.1.7, 2.3.1.8, 3.5.1), including short duration, small geographic scope, and low proportion of take compared with the populations, the localized IWDM activities explored in this EA are not expected to change this balance. The effects of WS-New Mexico activities are therefore temporary, localized, and of low magnitude (Section 3.5). Negative population-level effects on apex predators from APHIS-WS are very unlikely because predator populations are stable under the current and projected levels of cumulative take (Section 3.5.16).

The potential for substantive shifts in population age structure was analyzed for coyote populations in New Mexico, as they are the species most commonly taken by WS. Henke (1992, Henke and Bryant 1999) documented decreases in species richness and rodent diversity and increases in relative abundance of badgers, bobcats, and gray foxes in areas of Texas where year-round coyote removals resulted in a sustained 48% reduction in the local coyote population. However, considering that the statewide take of coyotes is less than 10% of the population, and WS contributes to less than 5% take of the estimated statewide population, PDM has a minimal effect on the overall ecosystems of New Mexico. Based on this information, we conclude that the impacts of the current WS-NM program are not of the sufficient magnitude or scope at the local or state level to adversely impact biodiversity or ecosystem resilience.

Under Alternative 1, we anticipate similar levels of PDM and associated take, therefore, under it is highly unlikely that WS-New Mexico's current and projected direct and cumulative take (Section 3.5.17.1) would contribute to any ecologically-forced trophic cascades, mesopredator releases, and any resulting adverse ecological effects on biodiversity, ecosystem resilience, or ecosystem services.

3.8.4.2 Alternative 2 comparative impacts on ecological trophic cascades

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners would be expected to continue to conduct PDM activities as described in Section 3.4. WS-New Mexico would have no take under this alternative.

With this alternative, WS-New Mexico 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 (as discussed in Section

3.4). 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 training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-New Mexico employees. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting DPM activities for those particular species (Section 3.4.2).

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Depending on the readiness and interest of other entities to conduct PDM activities, the cumulative number of predator removals could be greater than, less than, or similar to the cumulative take under Alternative 1. It is possible that more animals could be taken by other entities, as a result of less selective removals effort. Conversely, fewer animals may be removed in the absence of lethal operational assistance from WS-New Mexico because there may be fewer entities readily available to help address conflicts, and because individuals experiencing damage may not take action themselves. Lastly, there is the potential for predators to be removed by other entities at a similar level to WS-New Mexico's lethal take under Alternative 1.

Under Alternative 2, other entities would be expected to have a higher level of take compared to Alternative 1. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. However, take by other entities would not be expected to near annual maximum sustainable harvest levels established for the predator species, despite any reasonably foreseeable levels of increased take by other entities.

Therefore, under Alternative 2, there is no potential for WS-New Mexico to initiate a trophic cascade. Additionally, it is highly unlikely that take by other entities will contribute to any ecologically-forced trophic cascades, mesopredator releases, and any resulting adverse ecological effects on biodiversity, ecosystem resilience, or ecosystem services.

3.8.4.3 Alternative 3 comparative impacts on ecological trophic cascades

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. Lethal methods applied by WS-New Mexico would have slightly less take of predator populations as compared to Alternative 1. Non-lethal methods would have negligible impacts on predators. The APHIS-WS Decision Model may not be fully effective because if they are deemed necessary, lethal actions could not be used by WS-New Mexico during the time that non-lethal methods are attempted to address the immediate problems. Other commercial, governmental, and private entities and landowners would be likely to continue to conduct PDM activities as described in Section 3.4.

Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners could use trained and experienced WCOs or may implement lethal methods themselves. However, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). 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-New Mexico employees.

Under Alternative 3, predator populations are expected to remain stable with similar levels of take by other entities as under Alternative 1. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. However, cumulative take would not be expected to near annual maximum sustainable harvest levels established for the predator species, despite any reasonably foreseeable levels of increased take by other entities.

Therefore, under Alternative 3, there is no potential for WS-New Mexico to initiate a trophic cascade. Additionally, it is highly unlikely that cumulative take will contribute to any ecologically-forced trophic cascades, mesopredator releases, and any resulting adverse ecological effects on biodiversity, ecosystem resilience, or ecosystem services.

3.8.4.4 Alternative 4 comparative impacts on ecological trophic cascades

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. When WS-New Mexico responds with lethal control under the limited circumstances allowable under this alternative, the impacts on predator populations from WS-New Mexico would be less than those described for Alternatives 1 and 3, since fewer predators are removed under this alternative. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities as described in Section 3.4. Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

However, WS-New Mexico would not be able to respond with lethal methods to damage or threats to any other resources or situations. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). 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-New Mexico employees. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1.

Under Alternative 4, predator populations are expected to remain stable with higher levels of take by other entities compared to Alternative 1. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. However, cumulative take would not be expected to near annual maximum sustainable harvest levels established for the predator species, despite any reasonably foreseeable levels of increased take by other entities.

Therefore, under Alternative 4, there is no potential for WS-New Mexico to initiate a trophic cascade. Additionally, it is highly unlikely that cumulative take will contribute to any ecologically-forced trophic cascades, mesopredator releases, and any resulting adverse ecological effects on biodiversity, ecosystem resilience, or ecosystem services.

3.8.4.5 Alternative 5 comparative impacts on ecological trophic cascades

Under this alternative, WS-New Mexico would have no effect on predator populations or the potential to initiate a trophic cascade. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

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-New Mexico employees. Take of unprotected mammals by private individuals or their agent is not required to be reported to NMDGF, potentially resulting in underreporting, compared to WS-New Mexico's reporting under Alternative 1. However, while take by other entities would be higher than under Alternatives 1-4, cumulative take would not be expected to near annual maximum sustainable harvest levels established for the predator species, despite any reasonably foreseeable levels of increased take by other entities.

Therefore, under Alternative 5, there is no potential for WS-New Mexico to initiate a trophic cascade. Additionally, it is highly unlikely that cumulative take will contribute to any ecologically-forced trophic cascades, mesopredator releases, and any resulting adverse ecological effects on biodiversity, ecosystem resilience, or ecosystem services.

3.9 HUMANENESS AND ETHICS OF WS-NEW MEXICO PDM METHODS

The science of wildlife biology and management, including IWDM 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 (e.g., Kreeger et al. 1990, Proulx et al. 1993, Vucetich et al. 2007, Sneddon et al. 2014). WS-New Mexico personnel strive to undertake these activities as ethically and humanely as possible under field conditions.

3.9.1 What are the ethics and attitudes about wildlife damage management?

Ethics are standards of human conduct. The management of wildlife, especially if it involves lethal actions, can elicit varied emotional reactions, 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 (Section 1.4.2).

Humaneness is most often related to human interactions with wildlife, especially when humans kill, capture, or otherwise directly interact with animals. However, humaneness also pertains to human suffering caused by wildlife directly hurting or impacting them. In addition, some people are highly concerned with suffering caused by predation on wildlife and domestic animals, including horses, livestock guard animals, and pets. People have bred many of the defensive capabilities out of domestic animals and may feel it is unethical and inhumane not to effectively protect them from predation, as predators can have very inhumane killing techniques where animals are injured or ate on prior to or without being killed.

Additionally, humaneness is not always present in nature. 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. 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 (Section 3.8).

People's concern with humaneness falls on a spectrum. 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 (Section 1.4.2).

3.9.2 How are euthanasia and humane killing defined?

APHIS-WS policy and operations comply with the guidelines of the American Veterinary Medical Association (AVMA 2020), 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 (2020) 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 (2020) 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 (2020) states that personnel should be proficient and should use the proper firearm, ammunition, and trap for the species.

AVMA (2020) 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 field practices are 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.

In 2019, AVMA published a report titled *AVMA Guidelines for the Depopulation of Animals: 2019 Edition*. Depopulation of wildlife is defined in AVMA (2019) as the "rapid destruction of a population of animals in response to the urgent circumstances with as much consideration given to the welfare of the animals as practicable". Depopulation of wildlife is substantially different from the selective removal of damage-causing individuals, and is not proposed in this EA. WS-New Mexico has reviewed the publication, however, they do not apply to activities proposed in this EA. AVMA (2019) refers the reader to the AVMA Guidelines for the Euthanasia of Animals (AVMA 2020) for guidance on the types of actions WS-New Mexico is proposing.

3.9.3 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).

Assessing pain experienced by animals can be challenging (AVMA 2020, CDFG 1991). The AVMA defines pain as being, "that sensation (perception) that results from nerve impulses reaching the cerebral cortex via ascending neural pathways" (AVMA 2020).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).

Stress has been defined as the effect of physical, physiologic or emotional factors (stressors) that induce an alteration in an animal's base or adaptive state. Responses to stimuli vary among animals based on the animals' experiences, age, species and current condition. Not all forms of stress result in adverse consequences for the animal and some forms of stress serve a positive, adaptive function for the animal (AVMA 2020). It is the goal of professional PDM programs to minimize distress in animals to the maximum extent practicable.

Pain, anxiety, and stress caused by restraint and physical exertion due to struggling to escape can manifest physiologically through the sympathetic nervous system and interplay among hormones produced by the hypothalamus, pituitary and adrenal glands. Pain and stress can be measured through short-term increases in cortisol from the adrenal glands, heart rate, blood pressure, body temperature, and breathing rate, and a long-term loss of body weight. 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).

3.9.4 What factors influence selectivity and humaneness of trapping?

Several researchers and organizations have attempted to develop objective, comparable, and statistically relevant methods for evaluating selectivity and humaneness in captured animals (Olsen et al. 1986, Onderka et al. 1990, Phillips and Gruver 1996, Engeman et al. 1997, International Organization for Standardization 1999). The Association of Fish and Wildlife Agencies (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(Association of Fish and Wildlife Agencies 2005). 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. These BMPs are updated as new information, traps, and practices are developed, with the most recent BMPs updated in 2020. 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 (Association of Fish and Wildlife Agencies 2019c).

The Furbearer Conservation Technical Working Group of the AFWA has developed BMPs for each species (Association of Fish and Wildlife Agencies 2019c). 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

Updated furbearer trapping BMPs are available on AFWA's website: https://www.fishwildlife.org/afwa-inspires/furbearer-management

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.

3.9.5 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 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).

WS Directive 2.450 (Section 2.4.1.2) establishes guidelines for APHIS-WS personnel using certain types of capture devices and promotes continued 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. New Mexico state laws also regulate the use of traps, snares, and capture devices (Section 2.4.4.3, Section 2.4.4.7). 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-New Mexico continues to use and implement BMP tools and practices as they become available and when appropriate for PDM. 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.

3.9.5.1 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 3.10. 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.

Seasonality and timing of the use of physical capture devices is an important consideration for humaneness. The removal of predators during the spring months has the potential to result in litters of coyotes or other predators becoming orphaned. When WS-New Mexico conducts lethal PDM activities during the April-June period, sometimes one or both adults of a coyotes pair are killed and may have a den of pups in the vicinity. If the den cannot be located, pups may sometimes be fed and cared for by one or more members of a social group of coyotes associated with that den (Bekoff and Wells 1980). The only way to totally avoid this circumstance would be to refrain from conducting any predator removal efforts during this period of time.

Unfortunately, this is also the period during which some of the most serious predation problems occur, such as coyotes killing young lambs to feed their pups (Till and Knowlton 1983).

3.9.5.1.1 Foothold traps

Traps used in the United States and elsewhere have undergone extensive standards testing and selection as part of an international effort to optimize trap humaneness, selectivity, and effectiveness (Batcheller et al. 2000, Association of Fish and Wildlife Agencies 2006, White et al. 2020), and was partially funded by APHIS-WS (Association of Fish and Wildlife Agencies 2006). Humane traps should 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.

Published 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: https://www.fishwildlife.org/afwa-inspires/furbearer-management

3.9.5.1.2 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. Although injury rates in cage traps are lower than cables and snares, use of cage traps is a not without risk of injury to the captured animal because animals can injure themselves attempting to escape the trap (e.g., swelling, damage to teeth and muscles) (Shivik et al. 2005, Muñoz-Igualada et al. 2008). 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 NMDGF 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 (Way 2002, Shivik et al. 2005).

3.9.5.1.3 Foothold traps and snares

WS-New Mexico uses foothold snares most often for bears and occasionally for cougar, but rarely for smaller predators. Neck snares are used routinely for coyotes and often for most or all of the other predator species (Table 2.1, Table E.1). Snares are highly portable and can be readily adapted by the field biologist for use in the field for many situations.

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). WS-New Mexico's use of snares is highly selective to minimize unintentional captures (Section 3.7, Table 3.19). Turnbull et al. (2011) found recent models of 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 (Onderka et al. 1990, BMP 2016).

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).

Senate Bill 32 outlaws the use of lethal snares on public land in New Mexico. See section 2.4.3 for WS-New Mexico's policies for compliance with Senate Bill 32.

3.9.5.1.4 Shooting and use of trained dogs

WS-New Mexico 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 NMDGF prior to WS-New Mexico 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). WS-New Mexico is concerned for the well-being of pursuit dogs used for PDM and wants to avoid injury or exhaustion from a pursuit. WS-New Mexico minimizes these risks by considering the terrain, time of day, and duration of pursuit dog use to minimize the risk to both the pursuit dogs and the animal being pursued.

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-New Mexico personnel, are important for consistent safety and effectiveness.

New Mexico state law and regulations allow the use of pursuit dogs for coyote, and bear, cougar, and furbearers and during season. When dogs are used to hunt bear or cougar, the licensed hunter must be present continuously once any dog is released.

3.9.5.2 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 euthanasia, or for non-lethal take, such as immobilization. Impacts on human health and safety and the environment for chemical methods are evaluated in Section 3.10.3.

3.9.5.2.1 M-44 sodium cyanide

WS-New Mexico 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 direct 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 3.10.3.1) and have many restrictions in their use per the label (Section 2.4.1.6), 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 3.10.3.1). The risk of the animal being observed by a person before death is very low because of the restrictions on using this method in locations where public exposure is probable (Section 2.4).

3.9.5.2.2 Gas cartridge for denning

WS-New Mexico 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. 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, AVMA (2013) and APHIS-WS consider CO a humane euthanasia method.

3.9.5.2.3 What field immobilization methods are humane?

Immobilization drugs are used infrequently by WS-NM, primarily when needed to release an unintentionally captured animal that can't be safely restrained or to safely transport animals that can't be euthanized on site. 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-New Mexico prefers to use Telazol™ for most of the species that are immobilized.

Propiopromazine HCL is the tranquilizer used in Tranquilizer Trap Device (TTD). TTDs were developed by APHIS-WS NWRC as a means of sedating animals captured in foothold traps to reduce the potential for self-inflicted injuries. TTDs are small rubber nipples fastened to the trap jaw filled with 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. Due to animal welfare concerns (Section 3.9.6.2), TTDs are not currently used by WS-New Mexico.

3.9.5.2.4 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 (2020 Appendix A 1.7, 1.9) 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.

3.9.5.3 Conclusion

From FY 2015 through 2019, firearms, M-44s, and aerial shooting were the most consistently used for lethal take of many target predator species, with 97% of M-44 take being coyotes. Foothold traps, neck snares, cage traps were used to a lesser degree. Black bears are mostly caught with foot snares and shot with firearms and, more rarely, caught with culvert traps. Cougars are mostly taken with foot snares and captured with trailing dogs and humanely shot with firearms. Other than M-44s for lethal take of coyotes, chemical methods such as LPCs, sodium nitrate, chemical euthanasia, and immobilizing drugs are rarely used in the field by WS-New Mexico (Table 2.1 and Table E.1).

These methods are highly selective for target animals, with low unintentional takes of predator and non-predator species during WS-New Mexico PDM activities (Table 3.18). WS-New Mexico personnel are highly trained in the proper use of these methods, follow applicable policies, and utilize best practices to undertake these activities as ethically and humanely as possible under field conditions.

3.9.6 What are the comparative impacts of the alternatives on humaneness?

3.9.6.1 Alternative 1 comparative impacts on humaneness

All WS-New Mexico field personnel are highly trained in the use of lethal and non-lethal take methods, must follow APHIS-WS training, Directives, and ethics policies (Section 2.4), and have extensive field experience in their use and best practices. WS-New Mexico uses the species-specific BMPs for trapping documented by AFWA as applicable and effective based on specific conditions and availability of and funding for new traps. Field personnel are sometimes requested to provide training in the effective and humane use of capture methods by cooperators who wish to do their own work, when compliant with state law. Traps and snares used by WS-New Mexico are updated as often as funding allows, and field personnel trained in their use. APHIS-WS NWRC actively works to develop new methods and trap modifications to improve effectiveness, selectivity, and humaneness.

WS-New Mexico follows state laws and regulations regarding the setting and frequency of trap checks (Section 2.4.4.3).

APHIS-WS recognizes that not all devices recommended in the BMP guidelines for general public use meet the stringent performance requirements for use in APHIS-WS activities (or other professional wildlife management agencies), particularly for efficiency and durability. WS Directive 2.450 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 WS-New Mexico complies with applicable federal, state, and local laws and regulations. WS-New Mexico continues to use and implement BMP tools and practices as they become available and when appropriate for managing wildlife damage. Therefore, WS-New Mexico professional practices, experience, selectivity, and effectiveness in the use of capture and kill methods reduce the risk of suffering to the extent possible under field conditions, weather, APHIS-WS policy, and state laws and regulations. Landowners are notified of their responsibility for the safety of their pets and livestock on private land.

3.9.6.2 Alternative 2 comparative impacts on humaneness

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities as described in Section 3.4.

With this alternative, WS-New Mexico 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. WS-New Mexico would continue to practice and uphold high standards of humaneness and ethics, as described under Alternative 1.

However, in the absence of lethal assistance from WS-New Mexico, some people may feel that it is unethical and inhumane not to take lethal measures to protect domestic animals from predation, if necessary. 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 (as discussed in Section 3.4). 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 training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-New Mexico employees. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting DPM activities for those particular species (Section 3.4.2).

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Depending on the skillset of others, it is possible that more animals could be taken unintentionally or less humanely by other entities, as a result of less selective and less proficient removal efforts. Additionally, while WCOs are trained in BMPs other private entities are not required to follow BMP guidelines. Therefore, other private entities may have less ethical or less humane lethal PDM actions. While WS-New Mexico would still be available for lethal technical assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual's lack of experience and proficiency.

Therefore, under Alternative 2, there are likely to be less humane and ethical practices by other entities compared to Alternative 1.

3.9.6.3 Alternative 3 comparative impacts on humaneness

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. WS-New Mexico would continue to practice and uphold high standards of humaneness and ethics, as described under Alternative 1. The APHIS-WS Decision Model may not be fully effective because even if they are deemed necessary, lethal actions could not be used by WS-New Mexico during the time that non-lethal methods are attempted to address the immediate problems. Other commercial, governmental, and private entities and landowners would be likely to continue to conduct PDM activities as described in Section 3.4.

Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners could use trained and experienced WCOs or may implement lethal methods themselves. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). 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 training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-New Mexico employees. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting DPM activities for those particular species (Section 3.4.2).

Other entities would likely increase lethal IPDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Depending on the skillset of others, it is possible that more animals could be taken unintentionally or less humanely by other entities, as a result of less selective and less proficient removal efforts. Additionally, while WCOs are trained in BMPs , other private entities are not required to follow BMP guidelines. Therefore, other private entities may have less ethical or less humane lethal PDM actions. While WS-New Mexico would still be available for lethal technical assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual's lack of experience and proficiency.

Therefore, under Alternative 3, there are likely to be less humane and ethical practices by other entities compared to Alternative 1.

3.9.6.4 Alternative 4 comparative impacts on humaneness

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. WS-New Mexico would continue to practice and uphold high standards of humaneness and ethics, as described under Alternative 1. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities as described in Section 3.4. Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

However, in the absence of lethal assistance from WS-New Mexico for non-T&E species protection requests, some people may feel that it is unethical and inhumane not to take lethal measures to protect domestic animals from predation, if necessary. 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 (as discussed in Section 3.4). 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 training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-New Mexico employees. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting DPM activities for those particular species (Section 3.4.2).

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Depending on the skillset of others, it is possible that more animals could be taken unintentionally or less humanely by other entities, as a result of less selective and less proficient removal efforts. Additionally, while WCOs are trained in BMPs, other private entities are not required to follow BMP guidelines. Therefore, other private entities may have less ethical or less humane lethal PDM actions. While WS-New Mexico would still be available for lethal technical assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual's lack of experience and proficiency.

Therefore, under Alternative 4, there are likely to be less humane and ethical practices by other entities compared to Alternative 1.

3.9.6.5 Alternative 5 comparative impacts on humaneness

WS-New Mexico would continue to practice and uphold high standards of humaneness and ethics, as described under Alternative 1. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

Depending on the skillset of others, it is possible that more animals could be taken unintentionally or less humanely by other entities, as a result of less selective and less proficient removal efforts. Additionally, while WCOs are trained in BMPs other private entities are not required to follow BMP guidelines. Therefore, other private entities may have less ethical or less humane lethal PDM actions.

Therefore, under Alternative 5, there are likely to be less humane and ethical practices by other entities compared to Alternatives 1-4.

3.10 IMPACTS ON THE ENVIRONMENT AND RISK TO HUMANS AND DOMESTIC ANIMAL HEALH AND SAFETY OF WS-NEW MEXICO PDM METHODS?

This section evaluates the potential impacts and risks associated with mechanical and chemical PDM methods used by WS-New Mexico 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-New Mexico employees.

The analysis of each mechanical and chemical method is based on WS Formal Risk Assessments (Appendix F), with additional information included from WS-New Mexico activities and the literature where available.[1] All of the methods evaluated in this section are described in detail in Appendix A and summarized in Section 2.3.1.

Other issues related to the use of these methods and chemicals are evaluated in the following sections:

- Efficacy of PDM (Section 1.12)
- Impacts on predator populations (Sections 3.5 and 3.7)
- Impacts on predator and non-predator populations, including federally-listed threatened and endangered species from unintentional take (Sections 3.6 and 3.7)
- Humaneness of methods (Section 3.9)

APHIS-WS Directives and policies for the use of PDM methods are described in Section 2.4.1 through 2.4.3 and the associated state of New Mexico laws and regulations are included in Section 2.4.4.

3.10.1 What are the potential impacts and risks associated with mechanical/physical capture 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 shooting, 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 3.10.2.

3.10.1.1 What are the potential impacts and risks associated with physical capture devices?

WS-New Mexico 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. Descriptions of these methods are found in Appendix A. Risks associated with the use of mechanical/physical capture devices by APHIS-WS are examined in detail for each method in the *USDA, APHIS, WS Risk Assessments* (Appendix F).

[1] Refer to Section 3.4 for information regarding assumptions about lethal actions others might take to address predator damage in the absence of WS-New Mexico or if WS-New Mexico lethal activities are restricted.

3.10.1.1.1 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-New Mexico 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-New Mexico employees and/or any other person.

3.10.1.1.2 What are the potential risks from physical capture devices on public health and safety, including recreationalists and hunters, and domestic animals?

Per WS Directive 2.450, capture devices should be set to minimize the visibility of captured animals to the public (Section 2.4.1.2). Nearly 90% of total WS-New Mexico predator take occurs on private and state land (Table 2.2) and WS Directive 2.450 requires APHIS-WS employees to make reasonable efforts to obtain approval from adjacent landowners when setting traps or snares under fence lines to avoid capture of domestic animals (Section 2.4.1.2). 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 there is a risk of people being present, then, whenever possible, activities are conducted during periods when human activity is low, such as at night or early morning (Section 2.4.3.1).

Bilingual warning signs are used near trap sets placed on public lands to alert the public about hazards to people and domestic animals 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 (Section 2.4.3.1).

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. Depending on the situation and applicable laws and regulations, federal permittees could request either WS-New Mexico or others to conduct PDM activities. However, when WS-New Mexico conducts the activities, it notifies the land management agencies 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 (Section 2.4.3.1). This is not necessarily the case for PDM work conducted by other entities or individuals.

No pets/livestock have been unintentionally killed in FY 2015 through FY 2019 by WS-New Mexico. In the same five-year period, two pets/livestock animals were captured and freed unharmed, both in neck snares. Also, during FY 2015 through FY 2019 24 free-ranging/feral dogs were caught in foothold traps, neck snares, and leg snares. Of those, 15 were released unharmed and the remainder were unintentionally killed. During this same period, 18 free-ranging/feral dogs were killed with M-44's (Table 3.18).

This was less than 1% of the total take during the period of review. Therefore, the potential for the public, recreationists, hunters, landowners, and domestic animals to encounter and be captured or killed by a trap or snare set by WS-New Mexico and/or any other person/entity is very low on private lands and highly unlikely on public lands.

Senate Bill 32 (section 2.4.4.7) outlaws the use of lethal traps and snares on public land in New Mexico. See section 2.4.3 for WS-New Mexico's policies for compliance with Sente Bill 32. These policies will further reduce the potential risk from capture devices on public land in New Mexico.

3.10.1.1.3 What are the potential risks of using physical capture devices to WS-New Mexico employees?

WS-New Mexico employees operate 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 2.4.1.2). They must also participate in periodic firearms training (WS Directive 2.615, Section 2.4.1.3), which is important when firearms are used to euthanize captured animals.

WS has taken specific precautions to minimize the risk of employees being bitten by a diseased 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. Employees may also get bitten or scratched while setting an animal free or attempting to euthanize a captured animal.

WS Directives 2.601 and 2.635 (Section 2.4.1.12) address 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. When necessary, bears are 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. 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 A and Section 3.9). 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.

WS-New Mexico personnel follow WS Directives and standard safety practices, especially the use of PPE and safety requirements, which substantially reduces the risk of major or even minor injury during trapping and snaring activities, based on historical records. WS's formal risk assessments found that the risk to WS-New Mexico field employees is considered very low (Appendix F).

3.10.1.2 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 WS-New Mexico personnel to lethally take or euthanize wildlife during IWDM activities.[2]

Because firearms are inherently dangerous and use may occur under difficult conditions or high-profile public circumstances, WS has evaluated the potential human health and environmental risks from the proposed use of all types of firearms in a comprehensive Risk Assessment (Appendix F). APHIS determined that the risks to human health and the environment are negligible, as WS personnel are trained and certified to use firearms and ensure operations are conducted safely. Firearms and firearm-like devices are very selective for target animals, and WS personnel have been very effective in their use, with relatively few injuries and accidents nationwide. Thus, it was concluded that the use of firearms is of low risk to WS personnel, the public, nontarget species, and the environment.

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 2.4.1.3 and 2.4.1.4), 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

[2] The humaneness of using firearms for removing or euthanizing animals is discussed in Section 3.9.6. The use of firearms during aerial activities is discussed in Section 3.10.1.3. APHIS-WS policy for use of firearms is found in WS Directive 2.615 (Section 2.4.1.3).

for new APHIS-WS employees. The training requirement for firearms, 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 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)).

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.[3]

APHIS-WS field personnel select firearms appropriate to an intended use, and which include rifles, shotguns, air rifles, or pistols. For example, WS-New Mexico 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. 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 shooting teams.

Rifles are generally used to take animals accurately at greater distances. 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 to discharge rubber projectiles to physically hit and frighten animals. Shotguns are also used during aerial shooting to limit the risk of ricochet and increase effectiveness and efficiency of humanely killing the target predator (Section 3.9). 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. Handguns such as pistols are used for close-range euthanization 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 immobilizing 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.

[3] The risks to human health and safety and the environmental impacts and fate for lead used in ammunition are found in Section 3.10.2. In addition, further detail on risks associated with the use of firearms and lead ammunition maybe found in *USDA, APHIS, WS Risk Assessment, Chapter VI: The Use of Firearms in Wildlife Damage Management* and *Chapter XII: The Use of Lead in Wildlife Damage Management*, respectively (Appendix F).

WS-New Mexico uses firearms to lethally remove about 22% of predators, with over 95% of the take with firearms being coyotes. Firearms are also used to take black bears, striped skunks, raccoons, cougars, red and gray foxes, badgers, bobcats, opossums, and feral/free-ranging dogs and cats (Table 2.1, Appendix D Table E.2-2.1). Firearms are highly selective; WS-New Mexico employees rarely take animals unintentionally with this method (Table 3.18).

All firearms are safely carried and stored per WS Directive 2.615 (Section 2.4.1.3).

3.10.1.2.1 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 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 composed primarily of brass. Bullet casings from centerfires and shotgun hulls may be left on the ground, but are typically retrieved by field personnel, with the exception of shotgun hulls from aerial shooting. 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 cause the animals to flee and is not intended 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.

WS-New Mexico use of firearms and firearm-like devices for PDM is highly selective and has a negligible impact on the environment.

3.10.1.2.2 What is the accident risk of WS-New Mexico's use of firearms to the public, including recreationists, hunters, and domestic animals?

APHIS-WS and WS-New Mexico employees are highly trained and proficient in the use of firearms. They are trained to know the distance that different ammunition types fired from various firearms may travel before losing energy and are cognizant 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.[4]

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[4] The risks to human health and safety and the environmental impacts and fate for lead used in ammunition are found in Section 3.10.2. In addition, further detail on risks associated with the use of firearms and lead ammunition maybe found in *USDA, APHIS, WS Risk Assessment, Chapter VI: The Use of*

Dogs have been known to eat paintballs, which may cause toxicosis. However, with veterinary treatment, they typically recover within 24 hours (Donaldson 2003). WS-New Mexico is not aware of any dog having eaten a paintball it has used in PDM. WS-New Mexico anticipates rarely using paintball firearms for hazing predators.

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 domestic animals is negligible.

3.10.1.2.3 What are the potential risks to WS-New Mexico personnel from using firearms?

The risk to WS-New Mexico personnel's health with the use of firearms and firearm-like devices ranges from minor incidents to potentially significant accidents that may result in injury. 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 wound 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 program provides 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-New Mexico employees are highly familiar with the firearms they use, which ensures accuracy and safety. Nationwide, APHIS-WS employees have had 71 accidents or incidents with uses of all firearms between 2015 and 2019, average of 14.2 per year, typically by firearm and ammunition malfunctions (Table 3.19). Incidents due to operator error were minimal.

WS-New Mexico recorded only 1 incident involving firearms between FY 2015 and 2019, and an average of 14.2 were recorded nationwide in APHIS-WS. Although not identified specifically due to firearms, WS-New Mexico field employee accidents and resultant injuries overall are 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.

With proper and repeated training per WS Directives 2.615 and 2.625 (Section 2.4.1.3), 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 3.19.

Firearms in Wildlife Damage Management and *Chapter XII: The Use of Lead in Wildlife Damage Management*, respectively (Appendix F).

Table 3.19. APHIS-WS Nationwide Total and Average Record of Accidents and Incidents with Firearms and Firearm-like Devices during all IWDM Activities, FY 2015- FY 2019.

Firearm[1]	Operator Error (avg./yr)	Mechanical Failure (avg./yr)	Ammunition Failure (avg./yr)	Mishap (avg./yr)	Injury (avg./yr)
Shotgun	0.4	0.2	1.2	1.2	0.6
Rifle	1.8	2.6	1.4	1	--
Pistol	0.2	--	0.2	--	--
Air rifle	0.2	--	0.2	--	--
Pyrotechnic	--	--	0.4	--	--
Pellet gun	1.8	--	-	0.2	--
Average Total	4.4	2.8	3.4	2.4	0.6

No accidents were recorded due to use of dart guns or other non-lethal projectiles

3.10.1.3 What are the potential impacts and risks from the use of aircraft and aerial shooting?

WS-New Mexico uses fixed-wing aircraft and helicopters for intentional aerial shooting of coyotes (an average of 25% of total PDM lethal coyote take) on areas under agreement. In New Mexico, 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, CubCrafters CC-18 Top Cubs; and rotary-wing Hughes MD500 series.

APHIS-WS has analyzed the potential effects of aircrafts and aerial shooting used in IWDM on human health and the environment in a comprehensive risk assessment (Appendix F). WS pilots and crew members are trained and certified to ensure operations are conducted as safely as possible, and WS continues to evaluate and implement, where appropriate, new protection measures. WS has determined that the risks to people and the environment are minimal, and well within the norms of associated risks. WS will continue to support and conduct extensive training for pilots and crew members to make them more effective and further reduce these risks. There have been no unintentional take by WS-NM between 2015 to 2019 during aerial shooting activities, and no humans on the ground have been injured as a result of a crash or during aerial shooting.

APHIS-WS has used aerial shooting for over sixty years, with no known adverse impacts on any native wildlife populations, and adverse impacts are not anticipated in the future. APHIS-WS avoids other wildlife when observed during flying time. It is expected that WS-New Mexico aerial shooting and flights will not cause any long-term adverse impacts to non-target species, including those that are listed as threatened and endangered (WS-New Mexico 2015 BA and USFWS concurrence letter). In addition, there was no unintentional take by WS-New Mexico between 2015 and 2019 during aerial shooting activities, and no humans on the ground have been injured as a result of a crash or during aerial shooting.[5]

[5] Risks related to these activities are discussed in detail in *USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management* (Appendix F).

3.10.1.3.1 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 (Johnson and Reynolds 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 IWDM 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 equivalent to under two seconds per acre), on properties under agreement. APHIS-WS has concluded that disturbance effects on 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 (USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management (Appendix F)).[6]

3.10.1.3.2 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 (Appendix F).

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-New Mexico limits or avoids aerial shooting during hunting seasons, and it conducts most aerial shooting on or adjacent to livestock on private lands and less in remote areas. These measures prevent or limit overlap between aerial shooting and recreational uses. Furthermore, WS-New Mexico aerial shooting occurs mostly over private land where landowners would notify WS of ongoing recreational uses. When on public lands, WS-New Mexico 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 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-New Mexico conducts aerial shooting 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.

3.10.1.3.3 What are the potential risks to the health and safety of WS-New Mexico employees during aerial activities?

WS-New Mexico has not experienced any accidents or mishaps directly related to aerial shooting from FY15 to FY19.[7] WS-New Mexico has determined that the risk of accidents related to aerial shooting is less than that for general aviation.

3.10.1.3.4 What is the Potential for hazardous spills from an APHIS-WS aircraft crash?

The risk of fire or hazardous spills related to WS-New Mexico's aerial shooting 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, and no such incidents have been attributed to WS-New Mexico aerial operations (USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management (Appendix F)).[8]

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[6] Risk assessment details are available in *USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management* (Appendix F).

[7] Details of evaluation of risk from aerial activities to WS employees are in the *USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management* (Appendix F).

[8] Details on the evaluation of related risk can be found in *USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management* (Appendix F).

3.10.1.3.5 What is the potential for compromised physical security of APHIS-WS aircraft and related facilities?

WS-New Mexico 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-New Mexico has ever been stolen and the potential for such occurrences is considered negligible under all alternatives considered here.[9]

3.10.1.4 What are the potential impacts and risks from the use of trained animals?

A trained dog, as defined by WS Directive 2.445 (Section 2.4.1.14) 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 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.[10]

3.10.1.4.1 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. In some cases, a state permit may also 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.

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[9] Details on how these risks were evaluated and addressed can be found in *USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management* (Appendix F).

[10] Details of the evaluation of risk from the use of pursuit dogs and livestock guard animals can be found in *USDA, APHIS, WS Risk Assessment, Chapter XV: The Use of Dogs in Wildlife Damage Management* (Appendix F).

Compliance with the requirements of WS Directive 2.445 (Section 2.4.1.13) results in negligible risk of injury to non-target animals, restrained animals, or the environment.

3.10.1.4.2 What are the potential risks to the health and safety of WS-New Mexico 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 (USDA, APHIS, WS Risk Assessment, Chapter XV: The Use of Dogs in Wildlife Damage Management (Appendix F)).

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-New Mexico 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.

3.10.1.4.3 What are the overall environmental impacts and health and safety risks associated with the use of trained animals?

The limited number of WS-New Mexico field personnel experienced in the use of trained dogs, or currently using them, are required to protect both themselves and their dogs. WS-New Mexico personnel are also experienced with the training and behavior of valuable livestock guarding animals, and they are careful to protect themselves and the animals. The impacts and risks are negligible for both employees and animals under all alternatives involving WS-New Mexico field activities associated with livestock or the use of pursuit dogs for trailing or capturing predators.

For alternatives involving non-WS-New Mexico 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 presumably experienced. However, non-WS-New Mexico 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-New Mexico activities are restricted.

3.10.1.5 What are the comparative impacts of the alternatives from the use of physical/mechanical methods?

3.10.1.5.1 Alternative 1 comparative impacts from the use of physical/mechanical methods

The analysis for impacts on soil, water, and terrestrial and aquatic species indicates little to no effect on the environment from WS-New Mexico's use of any physical capture devices, shooting, aerial shooting, trained animals, or supplemental bear feeding. The effects of lead ammunition will be discussed in Section 3.10.2.

Risks to human health and safety, including recreationists, hunters, and domestic animals from WS-New Mexico's use of mechanical/physical methods is 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, the relatively short duration of PDM activities occurring in a particular area and protective measures as described in Section 2.4. WS-New Mexico employees have a high level of proficiency and are routinely trained in the use of mechanical/physical methods.

WS-New Mexico 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, based on historical records (Table 3.19). Reported injuries for WS-New Mexico over the last five years average less than one per year, mostly related to conducting operations in the outdoors, but not necessarily related to the use of the equipment. Therefore, the risk to humans and domestic animals from WS-New Mexico's use of mechanical/physical methods is very low on private lands and highly unlikely on public lands.

3.10.1.5.2 Alternative 2 comparative impacts from the use of physical/mechanical methods

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities as described in Section 3.4. With this alternative, WS-New Mexico 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 (as discussed in Section 3.4).

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-New Mexico employees. WCOs 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 (Section 3.4.2). Both private individuals and WCOs may not have the specific initial and reoccurring training for firearm, aerial shooting, and other methods that WS-New Mexico implements for its employees. The consistent use of PPE by private entities is likely to be lower than that used by WS-New Mexico 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. When aerial shooting, private individuals may spend more time flying over an area or implementing PDM methods as described in Section 3.4.

Since it is likely that most lethal methods used by private entities would be conducted mostly on private land, there is low likelihood that recreationists and hunters would encounter equipment placed by landowners or their agents. However, depending on the skillset of other entities in minimizing the risks to the environment, humans, and domestic animals, effects could be greater than, less than, or similar to those under Alternative 1. It is possible that the environment, humans, and domestic animals may have fewer exposures to PDM methods in the absence of lethal operational assistance from WS-New Mexico 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-New Mexico would still be available for lethal technical assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual's lack of experience and proficiency.

WS-New Mexico's effects on the environment, humans, and domestic animals from the use of mechanical/physical methods would be less than Alternative 1. Other entities would be expected to have greater effects on the environment, humans, and domestic animals from the use of mechanical/physical methods compared to Alternative 1.

3.10.1.5.3 Alternative 3 comparative impacts from the use of physical/mechanical methods

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. The APHIS-WS Decision Model may not be fully effective because lethal actions could not be used by WS-New Mexico 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 as described in Section 3.4.

During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners 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-New Mexico.

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-New Mexico employees. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting DPM activities for those particular species (Section 3.4.2). Both private individuals and WCOs may not have the specific initial and reoccurring training for firearm, aerial shooting, and other methods that WS-New Mexico implements for its employees. The consistent use of PPE by private entities is likely to be lower than that used by WS-New Mexico 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. When aerial shooting, private individuals may spend more time flying over an area or implementing PDM methods as described in Section 3.4.

Since it is likely that most lethal methods used by private entities would be conducted mostly on private land, there is low likelihood that recreationists and hunters would encounter equipment placed by landowners or their agents. However, depending on the skillset of other entities in minimizing the risks to the environment, humans, and domestic animals, effects could be greater than, less than, or similar to those under Alternative 1. It is possible that the environment, humans, and domestic animals may have fewer exposures to PDM methods in the absence of lethal operational assistance from WS-New Mexico 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-New Mexico would still be available for lethal technical assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual's lack of experience and proficiency.

WS-New Mexico's effects on the environment, humans, and domestic animals from the use of mechanical/physical methods would be similar to Alternative 1. Other entities would be expected to have greater effects on the environment, humans, and domestic animals from the use of mechanical/physical methods compared to Alternative 1.

3.10.1.5.4 Alternative 4 comparative impacts from the use of physical/mechanical methods

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. However, other commercial, governmental, and private entities and landowners would continue to conduct or increase their PDM activities as described in Section 3.4.

Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. 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-New Mexico employees. This lack of training and experience will likely increase adverse effects on the environment, humans, and domestic animals.

Because operational lethal actions would be limited and not available to manage damage to other resources, WS-New Mexico effects on the environment, humans, and domestic animals from the use of mechanical/physical methods would be less than Alternatives 1 and 3. Other entities would be expected to have greater effects on the environment, humans, and domestic animals from the use of mechanical/physical methods compared to Alternative 1.

3.10.1.5.5 Alternative 5 comparative impacts from the use of physical/mechanical methods

WS-New Mexico would have no effect on the environment, humans, and domestic animals from the use of mechanical/physical methods. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities.

Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. 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-New Mexico employees.

Therefore, effects on the environment, humans, and domestic animals by the use of mechanical/physical methods by other entities would be expected to be higher than under Alternatives 1-4.

3.10.2 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.

Humans and the environment have been, and can be, exposed to lead from a variety of sources. 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 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).[11]

APHIS-WS analyzed the risks of lead use in wildlife damage management to human health and the environment in a comprehensive risk assessment (Appendix F). Risk of lead related maladies from ammunition is minimized by training of WS personnel and the WS carcass disposal policy. WS is gravitating towards the use of non-lead ammunition as it becomes more available, and ecological impacts are reduced when carcasses are removed from the field. WS expects that the potential of lead toxicity from WS use to humans, especially children who are the most sensitive to the effects of lead, and the environment will be negligible. WS anticipates that this risk will continue to decline.

3.10.2.1 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

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[11] Further detail on risk associated with the use of lead ammunition may be found in *USDA, APHIS, WS Risk Assessment, Chapter XII: The Use of Lead in Wildlife Damage Management* (Appendix F).

a lead pellet or bullet to break up into small fragments once it strikes tissue or hard surfaces). When a lead bullet strikes tissue, it quickly begins to expand and break up into tiny pieces as it continues through the tissue. Gut piles 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 2017).

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 gutpiles with lead fragments). 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). 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 small children especially susceptible (IARC 2006, ATSDR 2016, EPA 2013).

In the environment, waterfowl, raptors, and scavenging birds are especially subject to lead poisoning from leaded ammunition. Waterfowl may pick up shot pellets from feeding on the bottom of lakes and ponds; raptors and scavenging birds may ingest it from wounded and dead game animals and gut piles left in the field. If ingested, 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). NMDGF requires shotgunners hunting any species of migratory game birds on all State Game Commission owned or managed areas must use and possess only USFWS-approved nontoxic shot.

As discussed in Sections 3.10.1.2 and 3.10.1.3, ground and aerial shooting are critical components of APHIS-WS activities. 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). 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.

The current use of non-leaded ammunition varies among states, but approximately 64% of the APHIS-WS programs nationally use less than 20% leaded ammunition. 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 (USDA, APHIS, WS Risk Assessment, Chapter XII: The Use of Lead in Wildlife Damage Management (Appendix F)). 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-New Mexico'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 2.4.1.3).

Average lead used by APHIS-WS programs nationally is approximately 11,249 pounds or approximately 5 metric tons per year. The amount of lead released into the environment from APHIS-WS activities less than 0.01% of the amount currently being released into the environment in the United States due to hunting, fishing and industrial activities (USDA, APHIS, WS Risk Assessment, Chapter XII: The Use of Lead in Wildlife Damage Management (Appendix F)).

For all activities throughout the country, 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-New Mexico adheres to landowner and land manager agreements (Directive 2.210, Section 2.4), and therefore would not use lead ammunition in any location where it was so specified within the agreement.

The EPA 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.
- **National Park Service (2017):** This 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). 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 3.10.2.

Inorganic lead is not a natural component of any biological system, and can affect many different components of the environment, including people. Review of the documents above indicates 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-New Mexico 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 gut piles left in the field (Section 3.10.2.5), and human ingestion of game meat shot with lead ammunition (Section 3.10.2.6), but the environmental impacts from those effects are low to negligible.

3.10.2.2 What is the environmental fate of lead and its exposure through soil and water media and uptake by terrestrial and freshwater plants?

Lead may be introduced to soil and water through WS-New Mexico PDM activities in several ways, including if an animal is fatally wounded in an aquatic environment and the body is not retrieved, if ammunition is discharged into aquatic areas, or if shooting predators on land, and either leaving the carcass in the field or the lead passing through the animal.

Lead fragments may move 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 when exposed to acidic water or soil, where it can then move through soil and into groundwater and surface water. Due to 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 6-8 inches (Cullen et al. 1996, Hui 2002, Laidlaw et al. 2005).

The average amount of lead used by APHIS-WS nationally is approximately 11,249 pounds or approximately 5 metric tons per year. WS-New Mexico uses an average of 384 pounds of leaded ammunition per year. The amount of lead released into the environment from APHIS-WS activities is less than 0.01% of the amount currently being released into the environment in the United States due to hunting, fishing and industrial activities.[12]

A representative average weight of soil is in the range of 110 pounds per cubic foot (Houlihan and Wiles 2001). The number of cubic feet of soil in the top six inches in one acre is about 21,780 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 2.4 million pounds (110 x 21,780). If considered over the amount of land area involved in WS-New Mexico wildlife damage management during a typical year (average of 12.9 million acres for FY 2015- FY 2019, the amount of lead distributed from such activities would constitute an average of about 0.000012655 ppm (mg/kg soil). Natural background levels of lead in soil range from 50-400 ppm (United States Environmental Protection Agency 2016) and the threshold for residential soil in a child's play area is 400 ppm (40 CFR 745).

Impacts of lead to soils, water, and plants from WS-New Mexico activities are expected to be negligible.

[12] Details of the evaluation of risks associated with the use of lead ammunition may be found in *USDA, APHIS, WS Risk Assessment, Chapter XII: The Use of Lead in Wildlife Damage Management* (Appendix F).

3.10.2.3 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 cold water 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 (USDA, APHIS, WS Risk Assessment, Chapter XII: The Use of Lead in Wildlife Damage Management (Appendix F)), 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-New Mexico 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-New Mexico 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.

3.10.2.4 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 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 2017).

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 2017).

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 the 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 2017). Despite apparent success from the ban on the use of lead shot for hunting waterfowl in North America in 1991, upland gamebirds (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 (United States National Park Service 2017).

The Breeding Bird Surveys (BBS) provide trend information on raptors from 1966 to 2015 and 2005 to 2015. Of the raptors in the Western BBS area, only the American Kestrel and White-tailed Kite show a significant decrease in their population from 1966-2015 (Sauer et al. 2017). These are two species likely unaffected by lead in carcasses as they primarily prey on insects and small mammals; lack of nest sites and clean farming, and specifically for the kestrel, the loss of prey from the use of insecticides, are likely reasons for their decline (Dunk 1995, Smallwood and Bird 2002). Two species of raptors that primarily scavenge, the turkey vulture and bald eagle, and would be most susceptible to lead-based reductions in their populations, show significant increases in their populations from 1966-2015. Another species that will scavenge readily, the golden eagle, shows a non-significant decreasing trend of -0.19%/year (95% CI = (-1.25 to 0.48). However, collisions with stationary objects and electrocutions were the greatest sources of mortality; lead is a concern, though it mostly has been found at sub lethal levels, but likely could weaken their immune and other systems (Kochert et al. 2002). Other species with non-significant decreasing trends include the northern harrier, northern goshawk, barn owl, western screech-owl, burrowing owl, and short-eared owl. In addition to bald eagles and turkey vultures, five other species show significant increases and include the red-shouldered, red-tailed, and Swainson's hawks, osprey, and merlin. The BBS New Mexico data shows similar trends except the Great horned owl, Northern Harrier, Golden Eagle, and American kestrel all show a slight declining trend. The overall BBS data basically shows that lead, especially for species that typically scavenge carcasses, is likely not impacting any population.

Exposure and risk to non-target birds will be greatest for those that consume animal carcasses containing with lead ammunition from APHIS-WS activities. However, the potential for lead exposure and risk to these types of scavengers will be reduced in instances where carcasses are removed by APHIS-WS. There is also the potential for lead exposure and risk to nontarget mammals and birds that may consume soil that could contain lead fragments or pellets. Risk would be greatest for birds that consume soil for grit to aid in digestion. The use of non-lead ammunition and pellets by APHIS-WS will remove the risk of lead exposure through these two exposure pathways. 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, APHIS-WS is increasing use of lead-free ammunition as new lead-free ammunition is developed and tested that meet APHIS-WS standards for safety, performance, and humaneness become reliably and cost-effectively available in adequate quantities for program use. 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.

3.10.2.5 What are the impacts of lead on terrestrial mammals and domestic animals?

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 gutpiles 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. (2012) 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, which would have been typical of lead ammunition ingestion. 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 3.10.2.6.
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-New Mexico, when practical, and the transition to effective non-lead alternatives when available and cost-effective, further reduces the already low risk of lead exposure to terrestrial mammals and domestic animals.

3.10.2.6 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, Golden et al. 2016, NPS 2017).

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 2017).

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 (Section 2.4.1.8). However, only meat that is processed 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 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-New Mexico activities is highly unlikely.

Impacts to human health from WS-New Mexico's PDM are very low due to the unlikely consumption of carcasses taken by WS-New Mexico. Additionally, the risk of contact with lead fragments from WS-New Mexico activities is minimal.

3.10.2.7 What are the comparative impacts of the alternatives from lead used in ammunition?

3.10.2.7.1 Alternative 1 comparative impacts of the use of lead ammunition

Impacts of lead to soils, water, plants, aquatic species, and invertebrates from WS-New Mexico sources of lead from PDM activities are negligible. Impacts of lead to birds and terrestrial mammal populations from WS-New Mexico sources are low.

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 policies and regulations, and for the choices made by individual hunters to use non-leaded ammunition. 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 early childhood can cause long-term effects on the central nervous system, with behavioral, cognitive, and physiological adverse impacts throughout life. APHIS-WS and WS-New Mexico use non-leaded ammunition when in accordance with federal and state law and when available, cost-effective, and effective for PDM purposes.

WS-New Mexico field personnel dispose of carcasses to make them less accessible to scavengers by putting them under brush, placing them in existing carcass pits on private property, or occasionally disposing of them in designated landfills or transfer stations when other methods are not feasible or available. 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-New Mexico employees 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-New Mexico through carcass disposal in the field is extremely low in comparison to that deposited from industrial sources and hunters. The overall BBS data basically shows stable or increasing trends for species that typically scavenge carcasses, and it is likely that lead contributed by WS-New Mexico is likely not impacting any populations.

Risks to human health and safety, including recreationists, hunters and domestic animals, from WS-New Mexico sources of lead is very low. WS-New Mexico 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 described in Section 3.4.

As humans are very unlikely to eat carcasses discarded in the field by WS-New Mexico, the risk of ingesting lead from WS-New Mexico activities is negligible. Lead from ammunition would be more likely to be ingested by humans from meat obtained by recreational hunting or, to a very limited degree, from meat donated by WS-New Mexico. Most shots are to a precise area on the animal resulting in a limited distribution of lead fragments through the edible meat. Therefore, the risk to humans and domestic animals from WS-New Mexico's use of lead is very low.

3.10.2.7.2 Alternative 2 comparative impacts of the use of lead ammunition

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities as described in Section 3.4. WS-New Mexico 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 (as discussed in Section 3.4).

It is possible that the environment, people, domestic animals, and the environment may have fewer exposures to lead in the absence of lethal operational assistance from WS-New Mexico because there may be fewer entities readily available to help address conflicts, and because individuals experiencing damage may not take action themselves. Conversely, the environment, humans, and domestic animals 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-New Mexico would still be available for lethal technical assistance and could advise private entities on applicable BMPs, these efforts would not compensate an individual's lack of experience and proficiency.

WS-New Mexico's use of lead would have no effect on the environment, humans, and domestic animals. Other entities would be expected to have greater effects on the environment, humans, and domestic animals from the use of mechanical/physical methods, compared to Alternative 1.

3.10.2.7.3 Alternative 3 comparative impacts of the use of lead ammunition

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. The APHIS-WS Decision Model may not be fully effective because lethal actions could not be used by WS-New Mexico 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 as described in Section 3.4.

During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners 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-New Mexico.

Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Assuming that commercial WCOs are experienced and proficient, effects of lead on the environment, humans, or domestic animals are probably low. However, landowners or other private entities could use more lead, taking more shots per animal, and improperly disposing of carcasses.

Effects on the environment, humans, and domestic animals from WS-New Mexico's use of lead would be slightly less than Alternative 1. Other entities would be expected to have greater effects on the environment, humans, and domestic animals from the use of lead compared to Alternative 1.

3.10.2.7.4 Alternative 4 comparative impacts of the use of lead ammunition

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control, including the use of firearms with lead ammunition, could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. However, other commercial, governmental, and private entities and landowners would continue to conduct or increase their PDM activities as described in Section 3.4.

Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. 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.

Effects on the environment, humans, and domestic animals from WS-New Mexico's use of lead would be less than Alternatives 1 and 3. Other entities would be expected to have greater effects on the environment, humans, and domestic animals from the use of lead compared to Alternative 1.

3.10.2.7.5 Alternative 5. No WS-New Mexico PDM activities

WS-New Mexico would have no effect on the environment, humans, and domestic animals from the use of lead. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities.

Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. 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 disposing of carcasses.

Therefore, effects of lead on the environment, humans, and domestic animals by other entities would be expected to be higher than under Alternatives 1-4.

3.10.3 What are the potential impacts and risks from the use of chemical methods?

In accordance with WS Directives 2.401 and 2.401 (Section 2.4.1.5), 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-New Mexico personnel must be registered with EPA and NMDA. 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.

Livestock Protection Collars (compound 1080)

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 and poses no risk to people, pets, or the environment.

3.10.3.1 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 (APHIS-WS 2017). It can only be used by trained, certified applicators who are directly employed by APHIS-WS or by private or public applicators trained and certified by the New Mexico Department of Agriculture. The state departments of agriculture in South Dakota, Montana, Wyoming, 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 PPE, 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-New Mexico cooperative agreement.

The FIFRA label issued by EPA to APHIS-WS for the M-44 device has 27 use restrictions, and state regulatory agencies can require additional restrictions within the state. The label and 27 use restrictions outline required measures to protect threatened and endangered species, public and pet safety, applicator safety, and unintentional/non-target species (Section 2.4).

M-44 devices are only used in rural public and private settings by WS-New Mexico for coyote and, rarely for gray fox, per EPA and APHIS-WS restrictions (WS Directive 2.415; Section 2.4.1.6). In New Mexico, 86% of PDM work involves coyotes, and just over 86% of that work is conducted on private or state land (Table 2.2).

From FY 2015 through 2019 WS took an average of 1,066 coyotes per year were taken with M-44s and only took a total of 95 nontarget animals including feral dogs, gray fox, kit fox, red fox, swift fox, and striped skunk total during the same time period.

WS has evaluated the potential human health and environmental risks from the use of sodium cyanide in a comprehensive Formal Risk Assessment (Appendix F). APHIS determined that the risks to human health and the environment are negligible, as WS personnel are trained and certified to use sodium cyanide and ensure operations are conducted safely. The risks to human health and safety and the environmental impacts and fate of sodium cyanide in M-44 devices are discussed below.[13]

3.10.3.1.1 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, 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 (Section 2.4.1.6) for M-44 devices prohibit its use within 200 feet of a non-frozen 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 non-frozen 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

[13] Further detail on risks associated with the use of sodium cyanide in M-44 devices are available in *USDA, APHIS, WS Risk Assessment, Chapter IX: The Use of Sodium Cyanide in Wildlife Damage Management* (Appendix F).

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.

3.10.3.1.2 What are the potential impacts on non-target mammals and birds from sodium cyanide in M-44s and sodium fluoroacetate in livestock protection collars?

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 3.9.5.2.1), the risk of non-target wild mammals and birds triggering an M-44 and getting a lethal dose is very low. In New Mexico, the nontarget rate with M-44's was 2.95% between FY 2015 and FY 2019. Nontarget species included feral dogs, gray fox, kit fox, red fox, swift fox, and striped skunk (Section 3.7).

No nontargets were taken with Livestock Protection Collars by WS-New Mexico between FY 2015 and FY 2019.

3.10.3.1.3 What are the potential risks to human health and safety of the public, recreationists, hunters, and domestic animals 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-New Mexico 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; and abide by the policies in WS-Directive 2.415. Per this directive, WS personnel is required to notify any occupied residence within 0.5 miles of an M-44 device prior to place. In addition, M-44 devices are not used within 600 feet of occupied residences, except those of a cooperating entity who has given written permission for WS to place a device on their property.

New Mexico Senate Bill 32 outlaws the use of M-44s on public land in New-Mexico (Section 2.4.4.7). This will further reduce the risk to humans and pets.

3.10.3.1.4 What are the potential risks to WS-New Mexico 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 APHIS-WS 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. No WS-New Mexico employee has been injured by using M-44s.

The risk to WS-New Mexico certified applicators is low as applicators receive proper training in the product's use, follow label instructions, wear protective clothing, including waterproof gloves and a face shield (Sodium Cyanide Risk Assessment Appendix F).

3.10.3.2 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 and skunks. 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 (Section 3.9.5.3.2).

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 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).

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 (Section 1.12.3). 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-New Mexico uses gas cartridges sparingly during PDM activities, mostly limited to coyote, with limited use on red fox dens (Table 2.1, Table E.1).

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.[14] 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.

Senate Bill 32 outlaws the use of gas cartridges on public land in New Mexico.

3.10.3.2.1 What are the potential risks to the public, recreationists, hunters, and domestic animals 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.

[14] Further detail on risks associated with the use of carbon monoxide in gas cartridges and forced gas fumigation systems are available in *USDA, APHIS, WS Risk Assessment, Chapter VIII: The Use of Carbon Monoxide from Gas Cartridges and Forced Gas Fumigation Systems in Wildlife Damage Management* (Appendix F).

3.10.3.2.2 What are the potential risks to APHIS-WS and WS-New Mexico field employees from sodium nitrate as used in gas cartridges?

Exposure risk for WS-New Mexico gas cartridge applicators has the potential to be higher than for the public, recreationists, hunters, and domestic animals 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-New Mexico employee has been injured by using gas cartridges. These cartridges are used by WS-New Mexico an average of once a year (Table 2.1, Table E.1). Therefore, the risk of any adverse impacts to WS-New Mexico employees is minimal.

3.10.3.3 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 A and evaluated for humaneness in Section 3.9.5.3.

WS Directives 2.505 and 2.430 (Section 2.4.1.9) provide guidance for euthanizing and immobilizing animals. All WS-New Mexico 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.[15] WS-New Mexico does not use immobilization drugs and does not anticipate doing so in the near future.

Immobilization drugs are metabolized and broken down by wildlife through natural metabolic processes over time. Some animals, such as a bear, could be immobilized just prior to or during a hunting season. In the event that WS-New Mexico uses immobilization drugs in the future, and is requested by NMDGF to immobilize a bear during a period of time where the drug withdrawal period (chemical metabolic breakdown) could overlap with a regulated harvest season, WS-New Mexico would either euthanize the bear or mark the animal with ear tags labeled with a “do not eat” warning prior to the bear’s release. This measure minimizes the risk of human exposure to residual immobilization drugs in the low likelihood that they consume game meat from a recently immobilized animal (Section 2.4.3.1).

WS Directive 2.515 (Section 2.4.1.8) 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, Section 2.4.1.5).

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[15] Further detail on risks associated with the use of immobilization and euthanasia (humane killing) drugs are available in *USDA, APHIS, WS Risk Assessment, Chapter XIX: The Use of Immobilization and Euthanasia Drugs in Wildlife Damage Management* (Appendix F).

WS-New Mexico has technicians certified for I&E use, however 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, both of which are rare. Use of immobilization drugs also requires the direction and approval of NMDGF because all wildlife relocated in the state must be approved by NMDGF 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 A).

3.10.3.3.1 What are the overall environmental impacts and health and safety risks associated with the use of I&E drugs?

I&E drugs are not widely used by WS-New Mexico, and are most often in conjunction with research, human health and safety concerns, or animal relocation. WS personnel must undergo training and certification in order to carry and administer these drugs. Drugs are administered at close range or by hand so there is negligible risk to release into the environment. Also, all drugged animals are either marked or disposed of in compliance with law and APHIS-WS policy. Therefore, the risk of adverse impacts from I&E drugs on the environment, animals, the public, recreationists, hunters, and WS-New Mexico field employees is negligible. No other entities would be expected to use I&E drugs.

3.10.3.4 What are the comparative impacts of the alternatives from the use of chemical methods?

3.10.3.4.1 Alternative 1 comparative impacts from the use of chemical methods

M-44s: EPA's use restrictions minimize the risk of impacts on the environment from M-44s. The risk to WS-New Mexico employees is low because 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 per year for verification. All applicators receive proper training in the product's use, follow label instructions, and wear PPE (including waterproof gloves and face shield). All sodium cyanide capsules not deployed in a device are locked and secured at all times, restricting the potential for a person to contact an isolated sodium cyanide capsule. No WS-New Mexico employee has been injured by using M-44s.

WS-New Mexico's compliance with EPA use restrictions also minimizes the risk to the public. For example, per the EPA registration, 26 use restrictions, and WS Directive (Section 2.4.1.6), the setting of M-44s is restricted in recreation areas, areas where exposure to the public and pets is probable, and from wilderness areas. Additionally, setting of M-44s is limited to areas within seven miles of properties where livestock losses have occurred (when used for protecting livestock) and are removed from an area if after 30 days there has been no sign that the target animal has visited the area.

Any use of M-44s on federal land must be documented with the federal land management agency. Label restrictions also limit the potential for humans or domestic animals to encounter a device set on public land. On private land, use of M-44s requires the consent of the landowner, who is requesting the use of M-44s. APHIS-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. On all lands with M-44s set, bilingual device signs are placed within 15 feet of the device. Additionally, entry signs are placed to alert the public to the presence of M-44 devices and warn not to tamper with them.

Individuals in remote areas away from paths or trails may encounter an M-44, but the risk is low, given that EPA requires that a maximum of 10 to 12 devices may be placed in any one square mile.

As described in Section 3.4, the risk to the public is further minimized because the EPA label restricts the potential for use of M-44s by other entities. The EPA product labels restrict use to only certified applicators, who are required to follow the label restrictions; the products are not commercially available to the unlicensed public. WS-New Mexico complies with the use restrictions on the product label.

A person finding a dead coyote is highly unlikely to either eat it or let their pet (i.e. dog) eat it. Any cyanide in the carcass would be distributed throughout tissues, resulting in further 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.

WS-New Mexico's compliance with the EPA use restrictions also minimizes the risk to non-target species. The small amount of sodium cyanide within a single capsule, and the restriction of its use within 200 feet of a water source, result in a negligible risk to terrestrial and aquatic organisms and water quality. The selectivity of M-44s to canids and low use by WS-New Mexico indicate that there is low risk of non-target wild mammals and birds triggering an M-44 and getting a lethal dose. The fate of sodium cyanide and hydrogen cyanide in the environment suggest the cyanide from a capsule would undergo biotic and abiotic degradation to non-lethal compounds.

Therefore, the risk to the environment, humans, and domestic animals is very low when used according to the restrictions in the EPA label and APHIS-WS directives.

Sodium nitrate: The risk of impacts on the environment, humans, 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-New Mexico employee has been injured by using gas cartridges, and the use of these cartridges by WS-New Mexico field personnel is infrequent.

I&E Drugs: Only highly trained field employees administer I&E drugs. Drugs are administered at close range or by hand, resulting in negligible effects on the environment, people, and 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-New Mexico field employees is negligible.

Therefore, based on detailed risk assessments (Appendix F) and the incorporation of protective measures (Section 2.4), the analysis of impacts on soil, water, and terrestrial and aquatic species indicates there would be little to no effect on the environment from WS-New Mexico's use of chemical methods. Additionally, risks to humans and domestic animals from WS-New Mexico's use of chemical methods are very low to negligible due to protective measures (Section 2.4).

3.10.3.4.2 Alternative 2 comparative impacts from the use of chemical methods

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Other commercial, governmental, and private entities and landowners will continue to conduct PDM activities as described in Section 3.4. WS-New Mexico 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. WS-New Mexico would only be able to use immobilization drugs under this alternative.

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 (as discussed in Section 3.4). Relatively few WCOs are available for large predator damage management, but landowners can request someone to work as their agent.

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. However few individuals would have the training and authorization to utilize chemicals that WS-New Mexico could use under Alternative 1. Under this alternative, M-44s will not be used since WS-New Mexico will be conducting non-lethal operational assistance only. Private use of M-44s in New Mexico would likely increase under this alternative. Private individuals are not likely to have the training and authorization to use immobilization and euthanasia drugs and it is unlikely that WCOs will have access to them. NMDGF, 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-New Mexico) to minimize effects on the environment, humans, and domestic animals. 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 New Mexico for use other than for WS-New Mexico. 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.

Effects on the environment, humans, and domestic animals from WS-New Mexico's use of chemical methods would be less than Alternative 1. Since chemical methods are limited for use by other entities, effects on the environment, humans, and domestic animals from the use of chemical methods by other entities would be less than under Alternative 1.

3.10.3.4.3 Alternative 3 comparative impacts from the use of chemical methods

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. The APHIS-WS Decision Model may not be fully effective because lethal actions could not be used by WS-New Mexico 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 as described in Section 3.4.

During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners 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-New Mexico.

However few individuals would have the training and authorization to utilize chemicals that WS-New Mexico could use under Alternative 1. There would likely be an increase in private use of M-44's under this alternative. Private individuals are not likely to have the training and authorization to use immobilization and euthanasia drugs and it is unlikely that WCOs will have access to them. NMDGF, 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-New Mexico) to minimize effects on the environment, humans, and domestic animals. 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 New Mexico for use other than for WS-New Mexico. 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.

Effects on the environment, humans, and domestic animals from WS-New Mexico's use of chemical methods would be slightly less than Alternative 1. Since chemical methods are limited for use by other entities, effects on the environment, humans, and domestic animals from the use of chemical methods by other entities would be less than under Alternative 1.

3.10.3.4.4 Alternative 4 comparative impacts from the use of chemical methods

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes in residential areas, or disease vector species. Any predator species have the potential to be threats to T&E species. Other commercial, governmental, and private entities and landowners would continue to conduct PDM activities as described in Section 3.4.

During (or instead of) WS-New Mexico's limited lethal assistance, landowners could still choose to address the problem by implementing PDM methods themselves. Landowners 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-New Mexico.

However few individuals would have the training and authorization to utilize chemicals that WS-New Mexico could use under Alternative 1. There would likely be an increase in private use of M-44's under this alternative. Private individuals are not likely to have the training and authorization to use immobilization and euthanasia drugs and it is unlikely that WCOs will have access to them. NMDGF, 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-New Mexico) to minimize effects on the environment, humans, and domestic animals. 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 New Mexico for use other than for WS-New Mexico. 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.

Effects on the environment, humans, and domestic animals from WS-New Mexico's use of chemical methods would be less than Alternatives 1 and 3. Since chemical methods are limited for use by other entities, effects on the environment, humans, and domestic animals from the use of chemical methods by other entities would be less than under Alternative 1.

3.10.3.4.5 Alternative 5 comparative impacts from the use of chemical methods

WS-New Mexico would have no effect on the environment, humans, and domestic animals from the use of chemical methods. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities.

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 (as discussed in Section 3.4). Relatively few WCOs are available for large predator damage management, but landowners can request someone to work as their agent.

There is a potential for other entities (as discussed in Section 3.4) to attempt to fill the need for lethal PDM activities in the absence of lethal operational assistance from WS-New Mexico. However few individuals would have the training and authorization to utilize chemicals that WS-New Mexico could use under Alternative 1. There would likely be an increase in private use of M-44's under this alternative. Private individuals are not likely to have the training and authorization to use immobilization and euthanasia drugs and it is unlikely that WCOs will have access to them. NMDGF, 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-New Mexico) to minimize effects on the environment, humans, and domestic animals. 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 New Mexico for use other than for WS-New Mexico. 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.

Since chemical methods are limited for use by other entities, effects on the environment, humans, and domestic animals from the use of chemical methods by other entities would be less than under Alternative 1.

3.11 IMPACTS OF WS-NEW MEXICO PDM ACTIVITIES ON SPECIAL MANAGEMENT AREAS

Special management areas (SMA) are federal lands that have unique cultural, scenic, educational, scientific, geological, or ecological values and are specially designated, to be managed to preserve their characteristics. Examples of these types of areas include designated wilderness areas (WAs) pursuant to the Wilderness Act, wilderness study areas (WSA), USFWS Refuges, Wild, Scenic, and Recreational Rivers, National Historic Trails, National Parks, National Monuments, Areas of Critical Ecological Concern, Research Natural Areas, or other SMAs. State agencies also manage some SMAs in New Mexico.

Work by WS-New Mexico in most SMAs ranges from no activity to seasonal PDM activities, based upon requests for services. For most SMAs, WS-New Mexico is requested to protect livestock, health and human safety, or T&E species. While requests for service in SMAs occurs on an infrequent basis, the potential exists that WS-New Mexico may be requested to work in all types of land classes and SMAs, as described in Sections 1.8.2 and 1.9.4. When requested to respond, WS-New Mexico would follow all applicable laws, APHIS-WS policies, MOUs, regulations, management plans, MRAs, and land management agency policies. Additionally, state agencies can request WS-New Mexico to conduct PDM in SMAs for state-managed wildlife species, when authorized by the state agency and the federal land management agency. WS-New Mexico coordinates all activities in SMAs with the appropriate land management agencies in Annual Work Plans (Section 3.11.3.2).

Table 3.20 shows the categories of SMAs where it is likely that WS-New Mexico could receive requests for assistance. WS-New Mexico's take of predators on public lands was approximately 9.4% of the total statewide (Section 1.9.4). Of that 9.4%, approximately 7.5% occurred on all BLM and USFS lands. The remaining percent was on other types of public lands (county, city, military, or other lands). Based on past activities, WS-New Mexico anticipates that most requests for assistance will be for WAs and WSAs. Therefore, this analysis focuses in detail on WAs and WSAs, however all SMAs are discussed in Section 3.11.3.

WS-New Mexico coordinates with federal WA and WSA land managers so that proposed PDM activities are consistent with the management needs for each individual area. Work in wilderness must be consistent with (a) the Wilderness Act, (b) each area's wilderness management plan, (c) the land management agency's wilderness management policies, (d) each area's individual wilderness legislation (which might contain special provisions applicable only to that particular wilderness area), and (e) IWDM MOUs between APHIS-WS and the wilderness management agency. Proposed activities in WSA must be consistent with BLM policy and management plan in which WSAs are managed to preserve wilderness character for possible future wilderness designations.

Table 3.20. Examples of Special Management Areas in New Mexico in which WS-New Mexico PDM Assistance Could Potentially be Requested.

Special Management Area Designation	Number	Acreage	Management Authority
Designated Wilderness Areas	17	1,428,407	USFS
	13	438,254	BLM
	2	56,392	NPS
	2	81,717	USFWS
Wilderness Study Areas	57	959,110	BLM
National Parks	1	46,766	NPS
National Monuments	4	748,755	BLM
	10	302,685	NPS
Total Acres		**4,064,983**	

3.11.1 How does the Wilderness Act affect PDM activities in wilderness?

The Wilderness Act of 1964 (16 U.S.C. 1131-1136) established a national preservation system for "*…lands designated for preservation and protection in their natural condition…"* (Section 2(a)) and "… *where the earth and its community of life are untrammeled by man…" (Section 2(c)).* Only Congress can designate federal wilderness areas, which are managed by several land management agencies including USFS and BLM, for "*…the public purposes of recreation, scenic, scientific, educational, conservation, and historical use."* (Section 4(b)). The agency that manages each wilderness area is responsible for preserving the wilderness character of each area according to its designated uses (Section 4(b)).

Section 4(d)(8) of the Wilderness Act left management authority for fish and wildlife with the states for those species under their jurisdiction. This includes the management of fishing, hunting, and trapping, subject to applicable state and federal laws and regulations, emphasizing the conservation of natural processes to the greatest extent possible.

The Wilderness Act prohibits certain uses and activities in wilderness areas (subject to some provisions): "… *there shall be no temporary [or permanent] road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area*." (Section 4 (c)).

In addition to these broadly applicable provisions of the Wilderness Act to all congressionally-designated wilderness areas, each statute designating a particular Wilderness Area identifies any management policies and activities that apply specifically to that wilderness, including recognizing pre-existing activities. Livestock grazing in some Wilderness Areas is a historical use that is permitted to continue (4(d)(4)(2).

3.11.2 What policies do the USFS and the BLM follow regarding PDM in Wilderness Areas and Wilderness Study Areas?

In New Mexico, designated wilderness is managed by USFS, BLM, NPS and USFWS, however WS-New Mexico anticipates the most requests for PDM assistance to be on USFS wilderness and BLM WAs and WSAs.

3.11.2.1 USFS Wilderness

The USFS follows the requirements of 36 CFR 293 and policies and objectives in FSM 2300 (Wilderness Management; 2007) and FSM 2650 (Animal Damage Management; 1995) regarding activities in wilderness and primitive areas.

FSM 2323.3 provides objectives and policies for management of wildlife and fish, including the recognition that states have jurisdiction and responsibilities for management wildlife and fish populations in wilderness in accordance with the Wilderness Act. Sections 2323.33c, 2323.33d, and 2323.33e recognize that predators and furbearers play a critical role in maintaining the integrity of natural ecosystems and that the benefits of a predator species in the ecosystem be considered before approving control actions. The section states:

> *The Regional Forester may approve predator control programs on a case-by-case basis where control is necessary to protect federally-listed threatened or endangered species, to protect public health and safety, or to prevent serious losses of domestic livestock. Focus control methods on offending individuals and under conditions that ensure minimum disturbance to the wilderness resource and visitors. Poison baits or cyanide guns are not acceptable…Only approve control projects when strong evidence exists that removing the offending individual(s) will not diminish the wilderness values of the area…The Regional Forester may approve other wildlife damage control projects on a case-by-case basis if necessary to protect federally-listed threatened or endangered species or for public health and safety… Under State laws, it is acceptable to trap furbearers, such as mink, marten, beaver, and muskrat, in wilderness when population levels justify a harvest program. Recognize the role of furbearers in natural ecosystems when making recommendations to State agencies on harvest.*

Sections 2323.36 recognize the need to control disease outbreaks:

> *The Forest Service, in cooperation with State and Federal public health authorities, may make special exceptions to policy and direction where necessary to control disease epidemics or other public health hazards in which wildlife or fish species are carriers. See FSM 2323.04 for approvals.*

3.11.2.2 BLM Wilderness

The BLM follows the policies and objectives of BLM Manual 6340 (Management of Designated Wilderness Areas; 2012) regarding wildlife damage control in designated wilderness areas. Wildlife damage management is specifically addressed in Section 21. c. viii which states in part:

Wildlife damage control in wilderness may be necessary to conserve Federally-listed threatened, endangered species, or candidate species, to prevent transmission of diseases or parasites affecting wildlife and humans, or to prevent serious losses of domestic livestock. Refer to MOUs between [APHIS-WS and BLM] regarding permissible action in wilderness.

Control measures should be implemented by APHIS-WS, the BLM, the State fish and wildlife agency, or other approved State agency, pursuant to cooperative agreements of memoranda of understanding…

Killing, hunting or otherwise controlling nonnative species also may be necessary to reduce conflicts with native species. Killing, hunting, or otherwise controlling native species, including those reintroduced, to reduce conflicts with other native species … is not permitted, unless mutually agreed upon between the State agency and the BLM, and is consistent with preservation of wilderness character…Nonnative, domestic, and feral animals may be killed, hunted, or otherwise controlled by Federal and State agencies to protect wilderness character.

BLM Manual 6340 also identifies the State wildlife agency having the primary role in managing wildlife and BLM responsibility to preserve wilderness characters:

"*In general the States possess broad trustee and police powers over fish and wildlife within their borders, including fish and wildlife found on Federal lands within a State." (43 CFR 24.3). Fish and wildlife management activities in BLM wilderness will be planned and carried out in conformance with the Wilderness Act's purpose of securing an "enduring resource of wilderness" for the American people through the preservation of each area's wilderness character…"*

3.11.2.3 BLM Wilderness Study Areas

WSAs are undeveloped lands that BLM believes meet at least the minimum qualifications of wilderness (roadless, usually larger than 5,000 acres, in a natural condition, with outstanding opportunities for solitude or a primitive and unconfined type of recreation) (Harmon and Jarvis 2011). WSAs may also contain ecological, geological, or other features of scientific, scenic or historical value (BLM 2015c). BLM manages these lands to ensure that their suitability for future wilderness designation would not be impaired. Existing rights are recognized and grandfathered uses, such as grazing and mineral extraction, are allowed with restrictions (BLM 2015c).

BLM Manual 6330 – Management of BLM Wilderness Study Areas (Rel. No. 6-134, 7/13/2012)[16] outlines procedures for BLM to ensure the Congressional mandate is met to manage Wilderness Study Areas "so as not to impair the suitability of such areas for preservation as wilderness." Wildlife and Predator or other wildlife damage control is addressed in Section 1.6, D. 10 and 11. Specific to predator damage management, APHIS-WS may implement PDM with BLM coordination to control predators in WSAs to:

"..to prevent transmission of diseases or parasites affecting human health or safety; to prevent transmission of diseases or parasites affecting other native wildlife; to protect domestic livestock within the WSA; or to enhance recovery of federally-listed threatened or endangered species…PDM actions may be taken by (APHIS-WS), BLM or delegated to a State agency. See BLM Manual 6830—Animal Damage Control.".

[16] BLM Manual 6330 – Management of Wilderness Study Areas (7/13/2012) replaced H-8550-1, Interim Management Policy for Lands Under Wilderness Review.

Additionally, BLM Manual 6330 acknowledges the states' authorities and need to manage wildlife populations:

> *"…effective management of WSAs requires close coordination and communication between the BLM and State wildlife management agencies. "In general the States possess broad trustee and police powers over fish and wildlife within their borders, including fish and wildlife found on Federal lands within a State." (43 CFR 24.3). Management actions taken to support wildlife management, whether proposed by the State or the BLM, must conform to the non-impairment mandate, as detailed in 1.6.C of this manual."*

BLM Manual 6830, Animal Damage Control affirms:

> *"Designated Wilderness and Wilderness Study Areas. Animal damage control in such areas may be necessary to protect federally listed threatened or endangered species, to prevent transmission of diseases or parasites affecting other wildlife and humans, or to prevent serious losses of domestic livestock. Control of nonindigenous species also may be necessary to reduce conflicts with indigenous species, particularly if the latter species are threatened or endangered."*

3.11.3 How does WS-New Mexico operate within Special Management Areas?

WS-New Mexico may conduct PDM in all WA's and WSA's when requested and authorized by the responsible government land management agency. The most likely request for assistance within the foreseeable future would be for a limited amount of PDM in WSAs and less frequent work in WAs. WS-New Mexico anticipates having a low likelihood of being requested to assist with PDM activities in the majority of the total WA and WSA special management areas for any reason.

Examples of work include PDM on grazing allotments in WAs and WSAs to prevent serious losses of livestock, work within the WA or WSA to protect livestock on neighboring properties, or when actively pursuing a predator from an adjacent property onto a WA or WSA. There is also a potential for the need to respond to a human health or safety emergency, such as for large predator threats at campgrounds. Additionally, state agencies can request WS-New Mexico to conduct PDM in SMAs for state-managed wildlife species, when authorized by the state agency and the federal land management agency. When requested to respond, WS-New Mexico would follow all applicable procedures and requirements discussed below.

Work in state lands, USFWS Refuges, Wild, Scenic, and Recreational Rivers, National Historic Trails, National Parks, National Monuments, Areas of Critical Ecological Concern, Research Natural Areas, military lands, or other SMAs would be extremely limited and WS-New Mexico would follow all applicable laws and policies of the appropriate land management agency. WS-New Mexico PDM activities in these areas would most likely be for the protection of health and human safety.

3.11.3.1 MOUs

MOUs between APHIS-WS and USFS, and between APHIS-WS and BLM, detail agency roles and responsibilities regarding PDM on USFS and BLM lands, respectively (Section 1.8.2). WS-New Mexico would follow all applicable laws, APHIS-WS policies, MOUs, regulations, management plans, MRAs, AWPs, and land management agency policies. In USFS WAs, WS-New Mexico will obtain written approval from the Regional Forester or its designee prior to beginning work. In addition, the USFS will document the minimum requirements analysis will be conducted for PDM in WAs.

3.11.3.2 Annual Work Plans

Each year, WS-New Mexico's discusses and reviews an Annual Work Plan with BLM, USFS, NMDGF, and other land management agencies as needed. Any anticipated PDM work in SMAs is incorporated into the Annual Work Plans which ensures that PDM is conducted in accordance with MOUs and all applicable laws and policies that guide land and resource management in each area. The Annual Work Plans will also discuss any applicable restrictions from additional legislation establishing a particular WA.

3.11.3.3 Written approvals and additional analysis of PDM in WAs

The MOU between APHIS-WS and USFS (2017) referenced above, documents the process for approvals and compliance with the requirements under the Wilderness Act. In a letter dated March 15, 2016, the Regional Forester authorized NM WS to initiate control of predators and other types of depredatory animals, when the following conditions are met.

1. Control is necessary to a) protect federally listed threatened or endangered species, b) protect public health and safety, or c) prevent serious losses of domestic livestock. Determination of serious losses will be made by APHIS-WS or the New Mexico Game and Fish Department after investigation, historical evidence, and patterns of loss show a habitual nature of kills or loss.
2. APHIS-WS personnel travel on foot or horseback to conduct control activities and control activities do not require any of the prohibited uses listed in Section 4)c) of the Wilderness Act. These prohibited uses include but are not limited to motor vehicles, motorized equipment, motorboats, aircraft, or other forms of mechanical transport, and structures or installations (e.g. traps or game cameras).
3. APHIS-WS notifies local USFS District Ranger prior to initiating any control activities. Ranger District personnel will notify the Forest Spervisor's office.
4. APHIS-WS has obtained any necessary permits from the appropriate State agency.
5. Once an action has been taken, APHIS-WS documents the location and justification for taking an animal and forwards it to the Regional Forester with a copy to the local USFS District Ranger. Ranger District personnel will notify the Forest Supervisor's office.
6. In human health, human safety, or livestock depredation cases where hot pursuit of a predator that began outside of wilderness but has migrated into wilderness, APHIS-WS is permitted to continue the pursuit for up to 12 hours after entry. Entry into wilderness must be by approved means listed in condition 2) above and the use of trailing dogs and shooting are the only control methods authorized. APHIS-WS must notify the District Ranger and Regional Forester within one business day after exiting wilderness and provide documentation that includes the reason for the action, date and location of the action, copies, of any permits related to the action, and number and species of animals removed.
7. APHIS-WS and the USFS meet once a year to review this policy as well as all control activities that occurred in wilderness.

The USFS letter does not grant approval for preventive control of any predator species in wilderness, the use of predacides in wilderness, or any of the prohibited uses outlined in Section 4 c) of the Wilderness Act.

The MOU between APHIS-WS and BLM (2020) [17] provides guidance on operational activities and coordination procedures for WS WDM activities on BLM land (Section 1.8.2), and outlines procedures for conducting WDM work on BLM land.

BLM Manual 6340, Management of Designated Wilderness Areas (2012), states that proposals that would involve uses generally prohibited under Section 4 (c) of the Wilderness Act (see EA Section 3.11.1) will be considered and may be authorized by the federal administering agency through the Minimum Requirements Decision Guide.

WS-New Mexico does not expect to implement any prohibited actions in WAs (such as landing aircraft or using motorized equipment), however, the BLM may also choose to produce a Minimum Requirements Analysis (MRA) regardless. Any chemicals used in wilderness must be approved by BLM (BLM Manual 6340 (2012)). Predator damage management in WSAs requires coordination with BLM (BLM manual 6330, 2012) (MOU 2020), and written approval.

3.11.3.4 Methods that may be used in Wilderness or Wilderness Study Areas

Table 3.21 shows select proposed PDM methods and activities that are generally proposed in this EA, and indicates whether or not they may be considered for use in WAs and WSAs. Allowed methods would be evaluated during the annual work planning process. Allowed methods may only be used if they are the minimum needed to resolve PDM in wilderness, conform to all federal and state laws including unique legislation designating each area, and are allowed under USFS and BLM policies and management plans for each specific WA or WSA, and MOUs between APHIS-WS and the appropriate land management agency.

Table 3.21. PDM methods and activities that are prohibited and those that may be allowed to be used in wilderness and wilderness study areas.

Method[1]	USFS Wilderness	BLM Wilderness	BLM WSA	Authorizing or Prohibiting Source
Education	Allowed	Allowed	Allowed	USFS Manual 2300; BLM Manual 6340 (wilderness); BLM Manual 6330 (WSA).
Physical exclusion	Prohibited	Prohibited	Prohibited	
Animal husbandry	Allowed	Allowed	Allowed	
Habitat management	Prohibited	Prohibited	Prohibited	
Modifying animal behaviors	Allowed	Allowed	Allowed	
Mechanical methods[2]	Allowed	Allowed	Allowed	
Aerial shooting & overflights	Allowed	Allowed	Allowed	

[17] If the MOU with BLM is revised, WS-New Mexico will comply with any changed or additional written procedures specified by that agreement.

Aircraft landing	Prohibited	Prohibited	Allowed	The Wilderness Act, Section 4 (c) prohibits these activities in wilderness; BLM Manual 6330 (WSA).
Ground shooting	Allowed	Allowed	Allowed	
Neck Snare	Prohibited	Prohibited	Prohibited	Senate Bill 32
Foot Snare	Allowed	Allowed	Allowed	
Foothold traps	Allowed	Allowed	Allowed	
Lethal body gripping traps	Prohibited	Prohibited	Prohibited	Senate Bill 32
Carcass disposal (left on-site)	Allowed	Allowed	Allowed	
Chemical repellents	Allowed	Allowed	Allowed	
Gas cartridges	Prohibited	Prohibited	Prohibited	Senate Bill 32
Tranquilizer and immobilization methods	Allowed	Allowed	Allowed	
Chemical and gas euthanasia	Allowed	Allowed	Allowed	
Physical euthanasia	Allowed	Allowed	Allowed	
M-44s	Prohibited	Prohibited	Prohibited	Senate Bill 32
Livestock Protection Collars	Prohibited	Prohibited	Prohibited	Senate Bill 32
Motorized equipment	Prohibited	Prohibited	Allowed	The Wilderness Act, Section 4 (c) prohibits these activities in wilderness; BLM Manual 6330 (WSA).
Vehicles	Prohibited	Prohibited	Allowed	The Wilderness Act, Section 4 (c) prohibits these activities in wilderness; BLM Manual 6330 (WSA).
Equine & foot travel	Allowed	Allowed	Allowed	USFS Manual 2300; BLM Manual 6340 (wilderness); BLM Manual 6330 (WSA).

[1] See Appendix A for description of methods.

2 See Appendix A.3 for types of mechanical methods, which include cage/box traps, quick-kill/body gripping traps, foothold traps, dog-proof/enclosed foothold traps, cable restraints (foot

snares and neck/body snares), trap monitors, catch poles, hand nets, net guns and launchers, dart guns.

3.11.3.5 Minimum requirements analysis

Proposed activities that would involve actions or uses generally prohibited under Section 4 (c) of the Wilderness Act may be considered and may be authorized by the federal administering agency through application of the Minimum Requirements Decision Process (MRDP). When an authorizing federal agency is responsible for conducting a MRDP analysis, the agency answers these questions:

> 1. Is the management action necessary to manage the area as wilderness, the public purposes of wilderness, and the specific wilderness character of the area (consistent with actions allowed within wilderness, including livestock grazing, law and policy, and other applicable guidance)?;
>
> 2. If the action is determined to be necessary, what is the minimum tool to meet the need that is the least degrading to the wilderness characteristics while safely, successfully, and reasonably accomplishing the task? This second question involves consideration of alternatives and mitigation measures related to impacts on wilderness characteristics (naturalness, outstanding opportunities for solitude or primitive and unconfined recreation, and other special features), as well as, to a lesser degree, time, convenience, and cost.

The decision resulting from the authorizing agency MRDP must be documented.

3.11.3.6 Role of states in wildlife management in Wilderness

In June 2006, the USFS, BLM, and the Association of Fish and Wildlife Agencies (representing the state wildlife management agencies) signed an agreement entitled "Policies and Guidelines for Fish and Wildlife Management in National Forest and Bureau of Land Management Wilderness" to provide for cooperative processes for ensuring that all agencies recognize the differing authorities and responsibilities for management of fish and wildlife in wilderness in accordance with the Wilderness Act. The guidelines serve as a framework for cooperation among the FS, BLM and the states in the coordination of fish and wildlife management in wilderness.

The FS and BLM are required to preserve wilderness character as directed by the Wilderness Act**,** while supporting the states' fish and wildlife objectives, to the extent such objectives are consistent with the Act. The guidelines refer to the MOUs between APHIS-WS and the land management agencies for matters involving IWDM, and to the Wilderness Act for actions normally prohibited. According to the guidelines, state activities that would involve various uses generally prohibited under Section 4 (c) of the Wilderness Act will be considered and may be authorized by the federal administering agency through application of the MRDP.

Additionally, state agencies can request WS-New Mexico to conduct PDM in SMAs for state-managed wildlife species, when authorized by the state agency and the federal land management agency. WS-New Mexico would work cooperatively with the state agency and federal land management agency to ensure that PDM activities were conducted according to all applicable state and federal agency policies, laws, and agreements.

3.11.4 What are the comparative impacts of the alternatives on Special Management Areas?

3.11.4.1 Alternative 1 comparative impacts on SMAs

WS-New Mexico's work in most SMAs ranges from no activity to seasonal PDM activities, based upon requests for services. For most SMAs, WS-New Mexico is requested to protect livestock, health and human safety, or T&E species. While requests for service in SMAs occurs on an infrequent basis, the potential exists that WS-New Mexico may be requested to work in all types of land classes and SMAs, as described in Sections 1.8.2 and 1.9.4. When requested to respond, WS-New Mexico would follow all applicable laws, APHIS-WS policies, MOUs, regulations, management plans, MRAs, and land management agency policies. Additionally, state agencies can request WS-New Mexico to conduct PDM in SMAs for state-managed wildlife species, when authorized by the state agency and the federal land management agency. WS-New Mexico coordinates all activities in SMAs with the appropriate land management agencies in Annual Work Plans (Section 3.11.3.2).

WS-New Mexico's take of predators on public lands was approximately 9.5% of the total statewide (Table 2.2). Of that 9.5%, approximately 7.9% occurred on BLM and 0.64% on USFS lands. The remaining 0.7% was on other types of public lands. Based on past activities, WS-New Mexico anticipates that most requests for assistance will be for WAs and WSAs. Work on state lands, USFWS Refuges, Wild, Scenic, and Recreational Rivers, National Historic Trails, National Parks, National Monuments, Areas of Critical Ecological Concern, Research Natural Areas, military lands, or other SMAs would be extremely limited and WS-New Mexico would follow all applicable laws and policies of the appropriate land management agency.

WS-New Mexico coordinates with federal wilderness and wilderness study area (WSA) land managers so that proposed PDM activities are consistent with the management needs for each individual area. Work in wilderness must be consistent with (a) the Wilderness Act, (b) each area's wilderness management plan, (c) the land management agency's wilderness management policies, (d) each area's individual wilderness legislation (which might contain special provisions applicable only to that particular wilderness area), and (e) IWDM MOUs between APHIS-WS and the wilderness management agency. Proposed activities in WSA must be consistent with BLM policy and management plan in which WSAs are managed to preserve wilderness character for possible future wilderness designations.

As described in Section 3.5 to 3.10, WS-New Mexico has low or negligible impacts on predator species populations, T&E species populations, species taken unintentionally, trophic cascades, humaneness, the environment, humans, or domestic animals from its activities. Due to the low likelihood and duration of work in SMAs, WS-New Mexico would have negligible effects on Special Management Areas.

3.11.4.2 Alternative 2 comparative impacts on SMAs

Under this alternative, WS-New Mexico would provide non-lethal and lethal technical assistance, and non-lethal operational assistance only. Federal land management agencies may conduct PDM on WAs and WSAs under their authority. NMDGF, under MOU with the USFS and or BLM, could conduct PDM activities in accordance with federal land management policies. Other private entities are authorized conduct their own PDM in these special management areas under state law and in accordance with federal land management policies, as described in Section 3.4.1. Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

With this alternative, WS-New Mexico 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. If technical assistance and non-lethal operational assistance from WS-New Mexico was not sufficient to manage damage in SMAs, 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 (as discussed in Section 3.4). 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 training with lethal methods, the experience to confirm the cause of damage, or the level of selectivity possessed by WS-New Mexico employees. Additionally, action by private entities may not be as closely coordinated with land management agencies. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting PDM activities for those particular species (Section 3.4.2). Additionally, greater presence of people and equipment may occur on WA or WSA and other SMAs when conducted by private entities, due to less efficiency and experience with lethal methods. Further, private individuals are not likely to coordinate as closely with the land management areas compared with the multiple levels of planning and coordination done by WS-New Mexico.

Effects on SMAs from WS-New Mexico's use of lead would be slightly less than Alternative 1. State agency or other federal land management agency PDM actions on SMAs would be expected to be similar to Alternative 1. Other private entities would be expected to have greater effects on SMAs compared to Alternative 1.

3.11.4.3 Alternative 3 comparative impacts on SMAs

Under Alternative 3, WS-New Mexico would provide technical assistance for both lethal and non-lethal activities, but the cooperator would need to apply reasonable non-lethal methods before WS-New Mexico would provide lethal assistance. The APHIS-WS Decision Model may not be fully effective because if they are deemed necessary, lethal actions could not be used by WS-New Mexico during the time that non-lethal methods are attempted to address the immediate problems. Other commercial, governmental, and private entities and landowners would be likely to continue to conduct PDM activities as described in Section 3.4.

Other entities would likely increase lethal PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. During (or instead of) WS-New Mexico's non-lethal assistance, landowners could still choose to address the problem themselves. If landowners determined that lethal PDM is immediately necessary, they may implement lethal methods before applying all reasonable non-lethal methods. Landowners could use trained and experienced WCOs or may implement lethal methods themselves. However, entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4).

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-New Mexico employees. Additionally, action by private entities may not be as closely coordinated with land management agencies. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting PDM activities for those particular species (Section 3.4.2). Additionally, greater presence of people and equipment may occur on WA or WSA and other SMAs when conducted by private entities, due to less efficiency and experience with lethal methods.

Effects on SMAs from WS-New Mexico's use of lead would be slightly less than Alternative 1. State agency or other federal land management agency PDM actions on SMAs would be expected to be similar to Alternative 1. Other private entities would be expected to have greater effects on SMAs compared to Alternative 1.

3.11.4.4 Alternative 4 comparative impacts on SMAs

Under Alternative 4, WS-New Mexico would provide full PDM technical and operational assistance (Appendix A), but lethal control could only be included as an option when responding to requests to protect human/pet health or safety, or federally-listed T&E species. WS-New Mexico could not use lethal methods as part of PDM to respond to other types of requests (e.g., agriculture, property, and game species). For threats to human and pet health or safety, the primary predator species of concern would be bears, cougars, or coyotes or disease vector species. Any predator species have the potential to be threats to T&E species. When WS-New Mexico responds with lethal control under the limited circumstances allowable under this alternative, the impacts on SMAs from WS-New Mexico would be less than those described for Alternatives 1 and 3, because fewer PDM actions would be implemented under this alternative.

WS-New Mexico would not be able to respond with lethal methods to damage or threats to any other resources or situations. Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4).

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-New Mexico employees. Additionally, action by private entities may not be as closely coordinated with land management agencies. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting PDM activities for those particular species (Section 3.4.2). Additionally, greater presence of people and equipment may occur on WA or WSA and other SMAs when conducted by private entities, due to less efficiency and experience with lethal methods.

Effects on SMAs from WS-New Mexico's use of lead would be slightly less than Alternative 1. State agency or other federal land management agency PDM actions on SMAs would be expected to be similar to Alternative 1. Other private entities would be expected to have greater effects on SMAs compared to Alternative 1.

3.11.4.5 Alternative 5 comparative impacts on SMAs

Under this alternative, WS-New Mexico would have no effect on SMAs. WS-New Mexico would not provide technical or directed assistance to individuals. Other entities are expected to fill the need for lethal PDM to some degree through other legal methods, as authorized by state agencies in coordination with land management agencies. Landowners experiencing damage or threats could only depend on advice and responses from commercial WCOs, NMDGF, or other entities. Entities requesting lethal assistance would have to determine if a commercial WCO or other private individual with the capabilities, approvals, and interest is available (as discussed in Section 3.4). Other entities would likely increase PDM actions in proportion to the reduction of services that would normally be provided by WS-New Mexico.

Without WS-New Mexico's technical and operational assistance, other entities may be less efficient and effective, potentially resulting in more impacts to SMAs. 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-New Mexico employees. Additionally, action by private entities may not be as closely coordinated with land management agencies. WCOs may not have the experience or response capability with some of the species and methods if they are not already conducting PDM activities for those particular species (Section 3.4.2). Additionally, greater presence of people and equipment may occur on WA or WSA and other SMAs when conducted by private entities, due to less efficiency and experience with lethal methods.

State agency or other federal land management agency PDM actions on SMAs would be expected to be similar to Alternative 1. In the absence of WS-New Mexico's assistance, the effects on SMAs from other private entities would likely be higher than under Alternatives 1-4.

3.12 Table 3.22 Summary of the Environmental Effects of Each Program Alternative by Issue

Alternative 1 **Proposed Action/No Action-Continue WS-New Mexico PDM Assistance**	**Alternative 2** **Technical PDM Assistance and Non-lethal Operational Assistance**	**Alternative 3** **Non-lethal PDM Assistance before Recommending or Applying Lethal PDM Assistance**	**Alternative 4** **Lethal PDM Assistance Only for Human/Pet Safety or to Protect T&E Species**	**Alternative 5** **No WS-New Mexico PDM Activities**
Impacts on Target Species				
Current and projected direct and cumulative take are well below maximum sustainable harvest levels as determined by a review of the available scientific literature. All predator species populations are stable as determined by NMDGF. WS-New Mexico is not, and would not, adversely impact any native predator populations.	WS-New Mexico would have no impact on predator species populations. Other entities would be expected to fill the need for lethal operational assistance to some degree and have a level of take similar to the cumulative take under Alternative 1. Take by other sources would not be expected to near the maximum sustainable harvest levels. Predator populations are expected to be stable.	WS-New Mexico would have slightly less impact on predator species populations compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary. Cumulative levels of take would be expected to be similar to Alternative 1 and would not be expected to near the maximum sustainable harvest levels. Predator populations are	WS-New Mexico would have less impact on predator species populations compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal PDM to protect other resources to some degree and have a level of take similar to the cumulative take under Alternative 1. Cumulative take would not be expected to near the maximum sustainable harvest levels. Predator populations are expected to be stable.	WS-New Mexico would have no impact on predator species populations. Other entities would be expected to fill the need for lethal operational assistance to some degree. Without WS-New Mexico involvement, other entities may be less efficient and effective, and therefore effects on predator species populations would likely be higher than under Alternatives 1-4. Predator populations are expected to be stable.

		expected to be stable.		
Impacts on T&E species				
WS-New Mexico has completed appropriate ESA consultations with USFWS to avoid jeopardy to T&E species including the Mexican wolf. WS-New Mexico is not likely to adversely affect any other T&E species or would have no effect. Effects are expected to continue to be minimal. WS-New Mexico would continue to conduct PDM to protect T&E species.	WS-New Mexico would have less impact on T&E species compared to Alternative 1. T&E species would not benefit from lethal PDM conducted by WS-New Mexico for T&E species protection. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher risks to T&E species than under Alternative 1.	WS-New Mexico would have slightly less impact on T&E species compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree if lethal PDM is deemed immediately necessary, potentially resulting in higher risks to T&E species than under Alternative 1.	WS-New Mexico would have less impact on T&E species compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher risks to T&E species, than under Alternative 1. WS-New Mexico would continue to conduct PDM to protect T&E species.	WS-New Mexico would have no impact on T&E species. T&E species would not benefit from PDM conducted by WS-New Mexico for T&E species protection. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher risks to T&E species. Without WS-New Mexico involvement, other entities may be less efficient and effective, and therefore adverse effects on T&E species would be expected to be higher than under Alternatives 1-4.
Impacts on Nontarget Species				
WS-New Mexico lethally takes very few individual animals unintentionally during its PDM activities and its activities are highly selective for specific predator species. WS-New Mexico's unintentional take is expected to remain negligible.	WS-New Mexico would likely take fewer individual animals unintentionally compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of unintentional take	WS-New Mexico would likely take slightly fewer individual animals unintentionally compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary,	WS-New Mexico would likely take fewer individual animals unintentionally compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of unintentional take	WS-New Mexico would have no unintentional take of individual animals. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in higher unintentional take. Without WS-New Mexico involvement, other entities may be less efficient and effective, and

	compared to Alternative 1.	potentially resulting in higher unintentional take compared to Alternative 1.	compared to Alternative 1.	therefore effects on species taken unintentionally would be expected to be higher than under Alternatives 1-4.
Potential for WS-New Mexico PDM Activities to Contribute to or Cause Ecological Trophic Cascades				
The effects of WS-New Mexico PDM activities on predator species populations are temporary, localized, and of low magnitude. It is highly unlikely that WS-New Mexico's current and projected direct and cumulative take will contribute to any trophic cascades.	WS-New Mexico would have no take. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of take compared to Alternative 1. However, it is highly unlikely that cumulative take by other entities will contribute to any trophic cascades.	WS-New Mexico would have slightly less take compared to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary. Cumulative levels of take would be expected to be similar to Alternative 1. It is highly unlikely that cumulative take will contribute to any trophic cascades.	WS-New Mexico would have less take compared to Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational assistance to some degree and potentially have a higher level of take compared to Alternative 1. It is highly unlikely that cumulative take will contribute to any trophic cascades.	WS-New Mexico would have no take. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in a higher level of take. Without WS-New Mexico involvement, other entities may be less efficient and effective, and therefore take would be expected to be higher than under Alternatives 1-4. However, it is highly unlikely that cumulative take by other entities will contribute to any trophic cascades.
Humaneness and Ethics of WS-New Mexico PDM Methods				
WS-New Mexico follows APHIS-WS training, Directives, and ethics policies. WS-New Mexico also follows state laws and regulations and utilizes BMPs, expertise, and highly selective methods to uphold high standards of humaneness and ethics.	WS-New Mexico would continue to uphold the same standards under Alternative 1. In addition, some people may feel it is unethical and inhumane not to take lethal measures to protect domestic animals from predation, if necessary. Other entities would be expected to fill the	WS-New Mexico would continue to uphold standards under Alternative 1. However, in cases where lethal PDM is deemed immediately necessary, it may be less humane and ethical to delay immediate lethal action. Other entities would be expected to fill the need for lethal	WS-New Mexico would continue to uphold standards under Alternative 1. In addition, some people may feel it is unethical and inhumane not to take lethal measures to protect domestic livestock from predation, if necessary. Other entities would be expected to fill the need for lethal	WS-New Mexico would have no effect on humaneness and ethics. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in less humane and ethical practices. Without WS-New Mexico involvement, other entities may be less humane and ethical

	need for lethal operational PDM to some degree. However, technical assistance would not compensate for private entities' lack of experience in lethal PDM, likely resulting in less humane and ethical practices compared to Alternative 1.	operational assistance to some degree, if they determine that lethal PDM is immediately necessary, potentially resulting in less humane and ethical practices compared to Alternative 1.	operational PDM to some degree. However, technical assistance would not compensate for private entities' lack of experience in lethal PDM, likely resulting in less humane and ethical practices compared to Alternative 1.	compared to Alternatives 1-4.
Impacts of PDM Methods on the Environment and their Risk to Human/Pet Health and Safety: Physical Capture Methods.				
The analysis of impacts on soil, water, and terrestrial and aquatic species indicates there would be little to no effect on the environment from WS-New Mexico's use of mechanical/physical methods. Risks to humans and domestic animals from WS-New Mexico's use of mechanical/physical methods are very low on private lands and highly unlikely on public lands due to short duration and protective measures.	WS-New Mexico's impact on the environment, humans, and domestic animals would be less than Alternative 1. Other entities would be expected to fill the need for lethal operational PDM to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.	WS-New Mexico's impact on the environment, humans, and domestic animals would be similar to Alternative 1. Other entities would be expected to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.	WS-New Mexico's impact on the environment, humans, and domestic animals would be less than Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational PDM to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.	WS-New Mexico would have no impact on the environment, humans, and domestic animals. Other entities would be expected to fill the need for lethal operational assistance to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals. Without WS-New Mexico involvement, effects on the environment, humans, and domestic animals would be expected to be higher than under Alternatives 1-4.
Impacts of PDM Methods on the Environment and their Risk to Human/Pet Health and Safety: Lead Ammunition				
Impacts of lead on soils, water, plants, aquatic species, and invertebrates from WS-New Mexico sources of lead is negligible. Impacts of lead on birds and terrestrial mammals	WS-New Mexico's use of lead would have no impact on the environment, humans, and domestic animals. Other entities would be expected to fill the need for lethal	WS-New Mexico's impact on the environment, humans, and domestic animals would be slightly less than Alternative 1. Other entities would be expected	WS-New Mexico's impact on the environment, humans, and domestic animals would be less than Alternatives 1 and 3. Other entities would be expected to fill	WS-New Mexico's use of lead would have no impact on the environment, humans, and domestic animals. Other entities would be expected to fill the need for lethal

from WS-New Mexico sources are low. Risks to humans and domestic animals from WS-New Mexico sources of lead are very low.	operational PDM to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.	to fill the need for lethal operational assistance to some degree, if they determine that lethal PDM is immediately necessary, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.	the need for lethal operational PDM to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals compared to Alternative 1.	operational assistance to some degree, potentially resulting in greater risks to the environment, humans, and domestic animals. Without WS-New Mexico involvement, effects on the environment, humans, and domestic animals would be expected to be higher than under Alternatives 1-4.
Impacts of PDM Methods on the Environment and their Risk to Human/Pet Health and Safety: Chemical Methods				
The analysis of impacts on soil, water, and terrestrial and aquatic species indicates there would be little to no impact on the environment from WS-New Mexico's use of chemical methods. Risks to humans and domestic animals from WS-New Mexico's use of chemical methods are very low to negligible due to protective measures.	WS-New Mexico's impact on the environment, humans, and domestic animals would be less than Alternative 1. Other entities would be expected to fill the need for lethal operational PDM to some degree, however because authorized use of chemical methods by other entities is limited, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.	WS-New Mexico's impact on the environment, humans, and domestic animals would be slightly less than Alternative 1. Other entities would be expected to fill the need for lethal operational PDM to some degree, however because authorized use of chemical methods by other entities is limited, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.	WS-New Mexico's impact on the environment, humans, and domestic animals would be less than Alternatives 1 and 3. Other entities would be expected to fill the need for lethal operational PDM to some degree, however because authorized use of chemical methods by other entities is limited, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.	WS-New Mexico would have no impact on the environment, humans, and domestic animals. Other entities would be expected to fill the need for lethal operational PDM assistance to some degree, however because authorized use of chemical methods by other entities is limited, the risks to the environment, humans, and domestic animals would be less than under Alternative 1.
Impacts on Special Management Areas (SMAs)				
WS-New Mexico would respond to PDM requests by land management agencies, state agencies, or livestock permittees	WS-New Mexico impact on SMAs would be less than Alternative 1. Other entities are expected to fill the need for lethal PDM to some	WS-New Mexico impact on SMAs would be slightly less than Alternative 1. Other entities would be expected to fill the need for	WS-New Mexico impacts on SMAs would be slightly less than Alternatives 1 and 3. Other entities are expected to fill the	WS-New Mexico would have no impacts on SMAs. Other entities are expected to fill the need for lethal PDM to some degree

on SMAs. In responding to requests, WS-New Mexico would work in close coordination with the land management agency, and comply with MOUs, applicable laws, agency policies, annual work plans, and as applicable, minimum requirements analyses. Currently, requests for assistance in SMAs are infrequently and of short duration. WS-New Mexico has negligible effects on SMAs.	degree through other legal methods, as authorized by state agencies in coordination with land management agencies. Impacts on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Impacts on SMAs from other private entities would be expected to be higher than under Alternative 1.	lethal operational assistance to some degree, as authorized by state agencies in coordination with land management agencies, if they determine that lethal PDM is immediately necessary. Impactss on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Impacts on SMAs from other private entities would be expected to be higher than under Alternative 1.	need for lethal PDM to some degree through other legal methods, as authorized by state agencies in coordination with land management agencies. Impacts on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Impacts on SMAs from other private entities would be expected to be higher than under Alternative 1.	through other legal methods, as authorized by state agencies in coordination with land management agencies. Impacts on SMAs from state and other federal agency PDM activities would be similar to Alternative 1. Without WS-New Mexico involvement, impacts on SMAs from other private entities would be expected to be higher than under Alternatives 1-4.

3.13 How does this EA Address WS-New Mexico's Stated Goal and Objectives?

Section 1.5.2.1 states the goals and objectives of WS-New Mexico PDM activities. This section identifies where the details in meeting the goals and objectives are addressed in the EA and how the alternatives compare in meeting the objectives. This section is not an environmental impact analysis. The vast majority of issues analyzed had little difference in impact among the alternatives because the Proposed and Current Action, Alternative 1, had very low impacts, however there was more variation among alternatives in meeting the objectives. Based on the information and analysis in each section, WS-New Mexico PDM activities meet the goal and objectives.

Goal: Meet the APHIS-WS mission of professionally supporting the coexistence of humans and wildlife

The following components of this goal are addressed throughout this EA. WS-New Mexico staff consistently responds to all requests for assistance to meet the following components of the goal:

- 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 (WS Decision Model WS Directive 2.201, Section 2.3.1.2) to evaluate, formulate, and implement or recommend the most effective strategy.

- The recommended strategy for each response intends to effectively 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/or long-term and are often a combination of lethal and/or non-lethal methodologies to ensure effectiveness.

Objectives:

Each objective listed below (Section 1.5.2) is addressed in the following sections of the EA:

1. Professionally and proficiently respond to all reported and verified losses or threats due to predators using the PDM approach using the Decision Model. PDM must be consistent with all applicable federal, state, and local laws, APHIS-WS policies and directives, cooperative service agreements, MOUs, and other requirements as required for any decision resulting from the Final EA.
    - Section 1.8: Description of how WS-New Mexico works with NMDGF, NMDA, and counties, including cooperative agreements
    - Section 1.8.2-3: MOUs between APHIS-WS and USFS, USFWS, and BLM
    - Section 1.11.2.7-1.11.4.7: NMDGF management rules for black bear and cougar
    - Section 2.3.1.2: Description of APHIS-WS Decision Model
    - Section 2.4: APHIS-WS relevant Directives and policies and NMDGF relevant laws and regulations for integrated predator damage management
    - Section 2.4: Use of APHIS-WS relevant Directives and NMDGF relevant laws and regulations in integrated predator damage management
2. Implement PDM so that cumulative effects do not negatively affect the viability of any native predator populations.
    - Section 3.5: Cumulative effects analysis for native predator populations for predators taken intentionally
    - Section 3.7: Cumulative effects analysis for native predator populations for predators taken unintentionally
    - Section 3.8: Cumulative impact analysis for native predator populations related to the potential to cause trophic cascades
3. Ensure that all PDM activities conducted by WS-New Mexico align with the management goals and objectives of applicable wildlife damage management plans or guidance as determined by the jurisdictional state, tribal, or federal wildlife management agency.
    - Section 1.11.2.7-1.11.4.7: NMDGF management rules for management of black bear and cougar in New Mexico

- Section 3.11: NMDGF, USFS, and BLM objectives and management of predator damage in special management areas, including wilderness areas and wilderness study areas
- Section 1.7.1: Intentional take of predators either under NMDGF authorization or reported to NMDGF per state law and regulations

4. Minimize non-target effects by using the Decision Model to select the most effective, selective, and humane remedies available, given legal, environmental, and other constraints.

- Section 1.12: Effectiveness of predator damage management
- Section 2.3.1.2: Description of APHIS-WS Decision Model
- Section 2.4: APHIS-WS relevant Directives and policies and NMDGF relevant laws and regulations for predator damage management
- Section 3.5: Impacts of PDM involving all known intentional and reported lethal takes of native predators
- Section 3.6 and 3.7: Impacts of PDM involving all known unintentional WS-New Mexico take of native predators
- Section 3.6 and 3.7: Impacts of PDM involving all known unintentional WS-New Mexico takes of non-predator species during PDM activities
- Section 3.6: Impacts of PDM involving all known unintentional WS-New Mexico takes of ESA-listed species
- Section 3.9: Analysis of the humaneness of PDM methods used by WS-New Mexico
- Section 3.10: Analysis of the impacts of PDM on the environment and risks to human health and safety

5. Incorporate the use of effective new and existing lethal and non-lethal technologies, where appropriate, into technical and direct assistance strategies.

- Section 1.12: Analysis of effectiveness of PDM activities
- Section 2.3.1 and Appendix A: Description of WS-New Mexico PDM activities, including methods
- Section 3.9: Analysis of the humaneness of methods used by WS-New Mexico for PDM

Table 3.23. Comparison of alternatives in meeting the objectives to support WS-New Mexico's goal to meet the APHIS-WS mission of professionally supporting the coexistence of humans and wildlife.

Alternative 1 Proposed Action/No Action Alternative: Continue WS- New Mexico PDM Activities	Alternative 2 WS-New Mexico Provides Lethal and Non-lethal PDM Technical Assistance and Only Non-lethal Preventive and Corrective Operational Assistance	Alternative 3 WS-New Mexico Provides Non-lethal PDM Assistance before Lethal Assistance	Alternative 4 WS-New Mexico WS-New Mexico provides lethal PDM only for human/pet safety or to protect ESA listed species	Alternative 5 No WS-New Mexico PDM Activities
Objective 1. Professionally and proficiently respond to all reported and verified losses or threats due to predators using the PDM approach using the Decision Model. PDM must be consistent with all applicable federal, state, and local laws, APHIS-WS policies and directives, cooperative service agreements, MOUs, and other requirements as required for any decision resulting from the Final EA.				
Meets objective.	Does not meet objective.	Does not meet objective.	Does not meet objective.	Does not meet objective.
Objective 2. Implement PDM such that cumulative effects do not negatively affect the viability of any native predator populations.				
Meets objective.	Meets objective.	Meets objective.	Meets objective.	Meets objective.
Objective 3. Ensure that all PDM activities conducted by WS-New Mexico align with the management goals and objectives of applicable wildlife damage management plans or guidance as determined by the jurisdictional state, tribal, or federal wildlife management agency.				
Meets objective.	Meets objective.	Meets objective.	Meets objective.	Does not meet objective.
Objective 4. Minimize non-target effects by using the Decision Model to select the most effective, selective, and humane remedies available, given legal, environmental, and other constraints.				
Meets objective.	Meets objective.	Meets objective.	Meets objective.	Does not meet objective.
Objective 5. Incorporate the use of appropriate and effective new and existing lethal and non-lethal technologies, where appropriate, into technical and operational assistance strategies.				
Meets objective.	Does not meet objective.	Meets objective.	Does not meet objective.	Does not meet objective.

CHAPTER 4. LITERATURE CITED

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CHAPTER 5. RESPONSES TO PUBLIC COMMENTS AND DOCUMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD

5.1 Responses to Public Comments

WS-New Mexico received 159 comment submissions on regulations.gov. Many of these comments were identical or substantially similar so "like" comments were grouped together. Below, we have summarized the comments into 54 individual comments and provided responses to them. All comments 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-New Mexico 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 New Mexico, NEPA documents from other WS states, lethal wolf management, providing habitat for wildlife, ranching/grazing laws, and other land management decisions that WS-New Mexico has no regulatory authority over.

2. **Commenters submitted numerous research articles without any context or explanation of why WS-New Mexico should consider them.** WS-New Mexico reviewed and considered all 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-New Mexico, if they did not add anything to the analyses in the EA, then WS-New Mexico did not site them, but did include them in the project record. 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. **Several commenters demanded WS-New Mexico prepare an EIS for the proposed action. Reasons included claims that proposed action causes significant impacts to the environment and wildlife populations in New Mexico, insufficient analysis in the EA, uncertain impacts, localized impacts, work on public lands, NEPA context and intensity factors, work in wilderness, and invalidation of EAs in other states.** WS-New Mexico's

decision to prepare an EA was addressed in Section 1.10. The results of the analysis indicated no significant impacts, which supports that decision. None of the reasons cited by commenters are triggers for preparation of an EIS on their own. The EA analyzed potential effects of the cited issues and determined there was unlikely to be any significant impacts that would warrant the preparation of an EIS. Section 1.10.1 of the EA defines how WS-New Mexico analyzed significance and cumulatively significant impacts.

4. **Discussion of the WS Decision Model is vague and that WS provides no detail how success is evaluated.** WS-New Mexico disagrees with these claims. A detailed discussion of the WS Decision Model (WS-Directive 2.201) is provided in section 2.3.1. 2 of the EA. The WS Decision Model is intended to conceptualize and describe the thought process involved in addressing wildlife damage problems. It is not intended to require documentation or a written record each time it is used. This directive provides WS personnel with a step-by-step approach to help address requests for assistance with wildlife damage. Step 6 of the Decision Model describes how WS monitors and evaluates the effectiveness and results of each project.

5. **The proposed action "may" establish a precedent for future actions with significant effects that would warrant preparation of an EIS.** WS-New Mexico disagrees with this claim. WS-New Mexico cannot predict where or what type of land class ex. (federal, state, tribal, public, private, WSA or WSA) we may be requested to provide PDM, but the EA explains how WS-New Mexico has predicted the level of PDM that may be necessary and how each conflict is evaluated in Section 1.9.3 and 2.3.1.7. WS-New Mexico applies the Decision Model and programmatic and site-specific protective measures to each request for assistance. The analysis indicated that these measures have been effective at preventing adverse impacts and will continue to minimize or prevent impacts. WS-New Mexico anticipates the take/use patterns to continue in the future but cannot predict when or where a request for assistance will come from with certainty. The analyses in this EA are intended to apply to any action that may occur in any locale and at any time within New Mexico for which WS-New Mexico may be requested for assistance.

6. **WS- New Mexico may not rely on annual work plan meetings with land managers, which take place behind closed doors without public involvement, to comply with both NEPA's environmental analysis and public disclosure requirements.** This is a false assertion. Neither NEPA nor CEQ regulations regarding the implementation of NEPA require work-planning meetings to include public involvement. WS-New Mexico is not required to involve the public in work planning meetings with other agencies or cooperators. APHIS NEPA Implementing Procedures describe the agencies requirements

for involving the public in major planning and decision processes. The scope of work discussed in these work-planning meetings, and contained in Annual Work Plans (AWPs), is covered by the analyses in this EA, as discussed in Sections 1.7 and 1.8.

7. **The EA fails to accurately describe the baseline data and conditions of the area to be affected by the proposed action.** WS-New Mexico disagrees with this claim. Refer to EA section (3.1 and Appendix E). 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). Thus, the baseline impacts are those for Alternative 1, the proposed action/no action alternative, as described in Section 2.3.1. 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).

8. **Site specific analysis is required to justify site specific actions.** WS-New Mexico does not agree with this comment. Site specificity and the use of the WS-Decision Model is adequately explained in section 1.9.3 of the EA. 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. Although WS-New Mexico 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-New Mexico. Therefore, WS-New Mexico must be ready to provide assistance, on short notice anywhere in New Mexico to protect any resource or human/pet health or safety.
   The APHIS-WS Decision Model (Section 2.3.1.2) is the site-specific procedure for individual actions conducted by WS-New Mexico personnel in the field when they respond to requests for assistance.

9. **We received numerous comments regarding the need for PDM in New Mexico. Many of these comments assert that there is no need for PDM to protect certain assets (*e.g.*, healthy livestock, humans, and pets) from predators, or that the need for PDM was**

inadequately described or justified. The purpose of WS-New Mexico's activities examined in the EA is to reduce environmental harms caused by predators that prey on or harass livestock and wildlife, damage other agricultural resources and property, impact wildlife species, or threaten human health and safety in New Mexico. WS-New Mexico thoroughly discussed and disclosed the Need for Action in Chapter 1 of the EA. There was no additional information brought forward to indicate that addressing predator damage in some capacity is not necessary. The analysis indicated that WS-New Mexico's PDM activities have been effective at preventing adverse impacts and will continue to minimize or prevent negative impacts.

10. **WS-New Mexico does not demonstrate that losses to livestock producers are sufficient enough to warrant PDM assistance and WS-New Mexico should set a threshold for providing PDM assistance.** The comment implies that a requestor would need to experience a certain amount of economic losses before receiving assistance. We discussed the idea of setting an economic threshold before providing assistance in Sections 1.4.3 and 2.5.6 of the EA. WS-New Mexico's responsibility is to provide assistance to those who request it, whether that is a larger cattle producer or a family with a backyard farm. Moreover, loss of livestock is not only quantified in terms of economic loss; loss of livestock can be emotionally devastating, especially if animals are viewed as pets or they suffer, which may be just as impactful, or more so, than an economic loss. Our goal is to alleviate conflicts upon request with an integrated approach, using lethal and non-lethal techniques, regardless of the economics of the situation.

11. **Killing wildlife to benefit other wildlife exceeds WS's Statutory Authority.** WS-New Mexico's authority to conduct PDM is thoroughly discussed in section 1.5 and 1.6 of the EA. WS-New Mexico has no authority for determining the appropriate management of wildlife populations that are under the jurisdiction of NMDGF and USFWS per their statutes, regulations, and species management plans and strategies, or management of species regulated in accordance with the ESA, the MBTA, or the BGEPA. Rather, WS-New Mexico responds to governmental and non-governmental requesters for assistance with PDM.

12. **Killing wildlife on public land violates the government's "public trust doctrine".** WS-New Mexico disagrees with this assertion. The Act of March 2, 1931 authorizes the Secretary of Agriculture to conduct a program of wildlife services. As amended in 1987, congress explicitly authorized Wildlife Services "to control nuisance mammals…". WS-New Mexico continues to act under that authority and in good faith with state and federal natural resource management partners. See EA Section 1.5.

    The Public Trust Doctrine is the foundation of State and Federal wildlife management programs in North America. The basis for the doctrine in the United States was established by the Supreme Court in 1842 (*Martin v. Waddell)* and subsequently supported by other case law rulings during the 19th through the 20th centuries. The Doctrine establishes that wildlife is a natural resource that belongs to the public and that should be maintained through government programs in trust for the people, including future generations. APHIS-WS conducts wildlife damage management according to the Public Trust Doctrine and its underlying public stewardship principles, not to generate revenue and profit for the Government. The Doctrine guides the relationship between natural resources that are publicly owned, and the Government wildlife management programs that provide stewardship to maintain the resources for the benefit of the public and future generations.

13. **Analysis of the Marin County California non-lethal program is biased and flawed.** WS-New Mexico disagrees with this claim. A thorough discussion and comparison of the Marin County, CA predator damage compensation program compared to WS PDM effectiveness is provided in section 1.3.5 of the EA. The cost of an expanded cost-share program aimed at responding to all WS-New Mexico requests and need for PDM would be considerably more than the estimate for the operation of the Marin County Livestock Protection Program which has a narrower scope of protection. WS-New Mexico also disagrees with the claim that it relies on a single source (Larson 2006) in determining the effectiveness of the Marin County program, refer to sections (1.13.5 and 2.5.24 0f the EA). The State of New Mexico also provides no subsidies for non-lethal methods to resolve damages from the predator species covered in this EA. We agree that predation damage management tools and techniques must be based on rigorous, scientifically-sound principles. But field and laboratory studies require different study designs. APHIS-WS scientists do not agree with Treves et al.'s assessment that existing research is flawed and believe it would be irresponsible to limit the ability of wildlife managers and trained experts to effectively resolve predator damage issues.

14. **We received numerous comments regarding the alternatives considered in the EA. Many of these comments assert that we did not or should have considered various alternatives.** WS-New Mexico chose to fully consider 5 reasonable Alternatives for comparative analysis, EA section 2.3. Consistent with NEPA regulations and CEQ guidance, WS-New Mexico reviewed 25 additional alternatives and ideas and briefly described those that are determined by the agency as not reasonable per the CEQ criteria and provided the agency's rationale for not considering them in detail in this EA (Section 2.5).

    Commenters claim that some level of Lethal PDM (operational or technical assistance) is considered in each alternative and that the EA must fully consider a nonlethal

methods only alternative. Section 2.5.2 of the EA describes the decision to not fully consider a nonlethal operational and technical assistance only alternative.

Commenters asked for a detailed consideration of an alternative that would replace lethal PDM with only effective, non-lethal strategies to resolves human-wildlife conflicts, except as necessary to address an immediate risk to human health or safety. Alternative 4 of the EA (*WS-New Mexico provides lethal PDM only for human/pet safety or to protect ESA listed species*) is similar to the suggested Alternative, but also includes the ability to use lethal methods for protecting ESA listed Species. The ability to use all available methods when WS is requested to assist with protecting ESA listed species is a critical component of our mission and is beneficial to species conservation and the environment. Therefore WS-New Mexico is not including the suggested alternative to the EA that only considers lethal methods to protect human safety.

Commenters suggest that WS consider an alternative prohibiting lethal wildlife PDM operations on all public lands. Section 2.5.19 of the EA provides a detailed description of why this Alternative was not one of the Alternatives in the EA considered in full detail.

Commenters suggest that WS consider an alternative prohibiting lethal wildlife PDM operations on wilderness and wilderness study areas. Section 2.5.20 of the EA provides a detailed description of why this Alternative was not one of the Alternatives in the EA considered in full detail.

Commenters suggest that WS consider alternatives prohibiting the lethal control of apex predators. Alternative 2 and Alternative 5 of the EA would both restrict WS-New Mexico from conducting lethal control of apex predators.

Commenters suggest that WS consider alternatives that restrict certain methods used in PDM activities. Agencies have the discretion to determine which alternatives to fully consider in their EAs. WS-New Mexico uses an integrated approach to PDM, and does not implement every method in every situation, instead selecting the most appropriate methods for each situation. Alternatives that would restrict individual methods could reduce the efficiency, safety, selectivity, etc. of WS-New Mexico's PDM activities and therefore will not be considered in this EA.

15. **Commenters claim that the agency's assumption that lethal PDM would occur in the absence of WS involvement is flawed.** We disagree with this claim. We fully analyzed the impacts and likely outcomes Alternative 5 (No WS-New Mexico involvement in PDM activities) in chapter 3 of the EA. Section 3.4.1 describes What other entities could respond if WS-New Mexico activities are modified or absent. Currently, NMDGF

provides direct wildlife damage management assistance for protected game and furbearer species and provides technical assistance and issues depredation permits for such activities as appropriate and within available resources. Requests for PDM information directed to WS-New Mexico would be redirected to NMDGF under Alternative 5.

16. **Commenters suggest that lethal PDM is not effective at preventing future conflicts with predators.** As discussed in section 1.12.1 of the EA; The need to repeat or continually implement a PDM method is not necessarily an indicator that the method is ineffective. Very few methods, nonlethal or lethal, provide permanent resolution of wildlife conflicts without ongoing effort. Just as lethal methods may need to be periodically repeated on the same property, nonlethal methods such as herding, livestock guarding animals, and frightening devices require sustained effort to implement for effective damage reduction, yet these methods are commonly perceived to be effective. WS-New Mexico responds to individual depredation events to assist in resolving those conflicts, then addresses the next conflict as requested and funded. Given the analysis in Chapter 3 of the EA that indicates predator populations quickly recover from removals by WS-New Mexico, this approach does not guarantee predation events will not recur at some later point. WS does provide technical assistance on methods that make it less likely for predation to reoccur (e.g., fencing, habitat management, carcass disposal, livestock husbandry practices, livestock guarding animals) where applicable.

    The ability of an animal population to sustain a certain level of removal and to eventually return to pre-management levels eventually does not mean management strategies were not effective for addressing the particular event, but that periodic lethal and/or non-lethal management actions taken during a critical time of the year in specific places may be necessary in specific circumstances. The return of local populations to pre-management levels also demonstrates that the species can tolerate localized removals while having minimal impacts on the species' population (EA Section 3.5).

17. **We received numerous comments questioning the efficacy of lethal PDM. Commenters claim that the EA fails to include a sufficient analysis of the effectiveness of WS-New Mexico's use of lethal methods to manage predators.** We disagree with this claim. Efficacy of PDM is adequately discussed in section 1.12.2 of the EA, including numerous references to literature cited by the commenters.

    Commenters suggest that WS-New Mexico failed to consider opposing opinions that challenge the efficacy of lethal PDM. WS-New Mexico disagrees with this claim. Section 1.12.2 provides adequate analysis on the effectiveness of PDM. WS-New

Mexico is not obligated to settle disputes regarding opposing opinions or disagreements among scientific researchers. According to CEQ, only a reasoned analysis of the evidence is required.

Commenters claim that WS-New Mexico failed to consider ten articles that show that there is better evidence for functional effectiveness in preventing livestock losses from nonlethal methods than from lethal methods.
We disagree with the assertion that the information presented by Treves et al. (2016), Treves et al (2019), and van Eeden et al (Sept 2018) represents the best available science for the reasons discussed in Section 1.12.4, 1.13.6.3, and 2.5.25 of the EA.

Eklund et al (2017), Khorozyan and Waltert (2020) and (in press bear study), Lennox et al (2018), Miller et al (2016), Moreira-Arce et al (2018), and van Eeden et al (Jan 2018) review previously published literature on wildlife damage management. The authors of these articles found that both lethal and nonlethal methods can be effective or ineffective, depending on environmental conditions, the predator species targeted for management, and the long-term goals of the management action. These articles do not add substantively to the information or analyses in the EA. Whether or not some of these studies met the criteria established by these authors does not imply that better science is available. In most instances.

18. **Commenters suggest that WS has failed to show that their efforts do not lead to higher livestock losses and the scattering of predators around the landscape after breaking up social networks with lethal control methods.** WS-New Mexico disagrees with this claim. Commenters did not provide any research or data to support this claim. WS-New Mexico has also not seen drastic increases in requests for assistance over decades of conducting PDM as might be expected had the ongoing PDM activities caused a significant increase in depredation of livestock in New Mexico. Section 1.11.2 of the EA provides a full breakdown of the need for PDM to protect livestock in New Mexico.

19. **Commenters claim that hunting for cougars may increase conflicts with livestock.** WS-New Mexico PDM activities for resolving cougar conflicts are significantly different than using hunting as a form of wildlife management at the state level. NMDGF has management authority for setting seasons and harvest limits for managing wildlife populations in New Mexico.

20. **Commenters claim that WS-New Mexico must prepare an EIS because WS-New Mexico failed to take a hard look at the effects of PDM on the environment.** WS-New Mexico disagrees with this claim. WS-New Mexico 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**.**

21. **Commenters claim that WS-New Mexico failed to take a hard look at the ecological impacts of removing carnivores, including the potential to cause impacts to biodiversity resulting in trophic cascades.** We agree that carnivores such as coyotes, mountain lions, and black bears play critical roles in ecosystems and that the extirpation of these species can result in negative impacts. We disagree that WS-New Mexico failed to take a "hard look" look at the ecological impacts. WS-New Mexico did take a "hard look" at the actions outlined in each of the alternatives and made reasoned decisions based on the analysis contained in the EA**.**

    We disagree with the claim that WS-New Mexico ignores the trophic cascade effects of predator control or the localized impacts of predator removal. Impacts of PDM on biodiversity and trophic cascade is adequately discussed in Section 3.8 of the EA. Many of the studies cited by commenters evaluate dramatic and long-term population reductions or complete eradiation of species, which is not analogous to WS-New Mexico PDM. The NEPA process does not require WS-New Mexico to settle disputes regarding opposing opinions or disagreements among researchers. Ripple et al (2014) and Ripple et al (2010) examined changes in landscape after the reintroduction of species after decades long extirpation. Callan et al (2013) compared wolf occupied areas in Wisconsin with low rates ranging from 0 to 3 years occupied. Crooks and Soule (1999) analyzed urban landscapes devoid of historically present coyotes. Estes et al. (2001) and Prugh et al (2009) discusses the impacts of historic extirpation of species from around the world, such as the 1960s eradication of rinderpest in the Serengeti. Henke and Bryant (1999) observed trophic cascade impacts only after they removed half of the coyote population from the landscape. WS-New Mexico does not eliminate entire populations from the landscape; therefore, these studies are not applicable to this EA. WS-New Mexico 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-New Mexico does not propose to disrupt or have a significant impact on any species populations or keystone species that would result in trophic cascades.

22. **Commenters claim that WS-New Mexico failed to take the requisite hard look at the cost-benefits of WS-New Mexico's PDM activities.** The assertion that the EA in in violation of NEPA because it does not include a cost-benefit analysis is false. NEPA does not require agencies to conduct an economic analysis or disclose financial information in EAs. This issue has been addressed in detail in Section 1.13. Based on a thorough review of the issue, we determined that a detailed economic analysis is not required by CEQ;

and that there are important qualitative values relevant and important to its decision-making that cannot be readily monetized. These values include recreational, aesthetic, safety, ecological and spiritual benefits. For these reasons, WS-New Mexico has determined that a formal cost-benefit analysis would not contribute substantively to WS' decision making at this time and has decided to address these issues qualitatively.

23. **Commenters claim that WS-New Mexico must prepare an EIS because the proposal is highly controversial and involves uncertain effects and unknown risks 40 C.F.R. § 1508.27(b)(4) and(b)(5).** We that the PDM activities conducted by WS-New Mexico is controversial and that an EIS is required due to unique or unknown risks. We included consideration of the degree of uncertainty and unique or unknown risks in our analyses in Chapter 3 and determined that there would be no significant impacts under Alternative 1. Our analyses in Chapter 3 demonstrate that Alternative 1 would not significantly impact the environment. The failure of any particular organization or person to agree with every act of a federal agency does not create controversy regarding effects. Dissenting or oppositional public opinion, rather than concerns expressed by agencies with jurisdiction by law or expertise and/or substantial doubts raised about an agency's methodology and data, is not enough to make an action "controversial" and is addressed in Section 1.10.2. Direct comparisons of this EA to *Wildlands v. Woodruff* (151 F. Supp. 3d 1153, 1165 [W.D. Wash 2015]) and *WWP v. APHIS-WS* (320 F. Supp. 3d, Idaho 2018) are not appropriate. WS in these cases the courts found that WS did not take a hard look at significant issues regarding the effectiveness of PDM, dismissed comments from other agencies, and failed to detail PDM methods that coincided with the scope of the EA. In this EA, WS-New Mexico provides reasoned analyses of the effectiveness of PDM in Section 1.12 and addresses the scope of the EA in Section 1.9. WS-New Mexico also consults extensively with state and federal agencies to ensure consistency with their land management plans, which is explained in Sections 1.6, 1.7, and 1.8.

24. **Commenters Claim that WS-New Mexico uses outdated literature/research on the effectiveness lethal PDM.** We disagree with the assertions that WS-New Mexico did not use the best available science in the EA, used outdated science, ignored dissenting scientific documents and opinions, or failed to consider important relevant documents related to the effectiveness of lethal vs nonlethal PDM. This assertion is true only to the extent that the EA contains some older citations generally related to species biology that has not changed in decades, or historic population trends provided as background information for the analysis. WS-New Mexico reviewed and cited the best available science in the preparation of this EA, with extensive literature citations provided in the Chapter 4 and 5.2, 5.3, 5.4, 5.5, and Appendix E. These citations include relevant studies from the papers that the commenters provided during public comment. We considered

numerous documents which were relevant to the use of lethal and nonlethal methods in the EA, but did not add substantively to the information and analyses in the EA. This was largely because we cited other references which contained similar information for the purposes of the analyses. Not all studies were cited; only those which added substantively to the information and analyses in the EA.

25. **Commenters claim that WS-New Mexico fails to address whether its PDM activities are consistent with governing federal land management plans and that WS has failed to evaluate and publicly disclose how its activities meet the consistency provisions of National Forest Management Act and Federal Land Policy and Management Act.** WS-New Mexico disagrees with this Claim. Section 1.8 of the EA fully describes how WS-New Mexico coordinates with these land management agencies before performing PDM activities on lands under their jurisdiction through Annual Work Plans (AWPs). The federal land management agencies USFS and BLM prepare land management plans per the National Forest Management Act (USFS) and FLPMA (BLM) that guide long-range management direction and include action constraints for protecting sensitive resources. Commenters also falsely claim that WS violates NEPA by not including the public in AWP meetings or disclosing meeting records. NEPA does not require federal agencies to involve the public in interagency agency planning meetings and does not require agencies to disclose records from interagency meetings.

26. **Commenters question the accuracy of recordkeeping by WS-New Mexico and claim WS-New Mexico should provide more detailed reporting.** WS-New Mexico disagrees with this claim. As stated in Sections 1.5.3.1 and 3.3 WS-New Mexico personnel follow WS Code of Ethics (Directive 1.301), accurately report field activities (WS Directive 4.205), and follow all federal, state, and local laws and regulations. All APHIS-WS personnel are required to accurately report their field activities and technical assistance work in the MIS database, including all animals taken intentionally and unintentionally, whether lethally or released (WS Directive 4.205). Per APHIS-WS policy, 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 IPDM activities reviewed the accuracy of recording field activities, among other issues (Section 1.12.2). The audit concluded that APHIS-WS complied with all applicable federal and state laws and regulations regarding wildlife damage management. The audit concluded that APHIS-WS was generally in compliance with all applicable laws. Of almost 30,000 entries in the MIS, 98% were correct with discrepancies of 2% identified, including both under- and over-reporting of take. APHIS-

WS is committed to and actively addressing OIG recommendations intended to further reduce discrepancies (OIG 2015).

27. **Commenters claim that PDM methods used by WS-New Mexico are indiscriminate and inhumane.** We disagree with this claim. WS-New Mexico uses an integrated approach to PDM that includes the option to use a variety of methods and techniques to resolve PDM conflicts (Appendix A). The potential for traps, M-44s, snares and other PDM methods to impact non-target animals, threatened and endangered species, human and pet safety, public lands, and wilderness areas was included in our analyses in 3.5.1, 3.6.1, and 3.7.1. Protective measures for the use of all proposed PDM methods by WS-New Mexico are included in Section 2.4 of the EA. Humaneness and Ethics of WS-New Mexico's PDM activities is fully discussed in section 3.9 of the EA. APHIS-WS NWRC is constantly working to develop and test new lethal and non-lethal methods for predators. APHIS-WS and WS-New Mexico field personnel are highly experienced and trained in use and deployment of methods to increase effectiveness and selectivity (Sections 3.7 and 3.9).

28. **A commented suggested that WS-New Mexico use trap monitors to increase humaneness.** WS-New Mexico does use trap monitors for projects where they are practical and effective. 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-New Mexico continues to look for opportunities to test current and developing systems.

29. **Commenters Claim that WS-New Mexico dismisses the impact noise from low-level flights on wildlife.** WS-New Mexico disagrees with this claim. This issue is adequately discussed in section 3.10.1.3.1 of the EA. WS-New Mexico cited numerous studies in the EA related to the effects of low-level flights on wildlife. WS has concluded that disturbance effects on 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 (USDA, APHIS, WS Risk Assessment, Chapter V: The Use of Aircraft in Wildlife Damage Management (Appendix F)).

    Aerial shooting occurs only on lands where it is authorized and when under agreement, primarily on private lands. Aerial operations conducted by New Mexico WS are minor in terms of geographic scope because 94% of the land area in New Mexico is not exposed to any such activity. Of the total hours WS flew 74% on private and state lands, 12% on BLM lands, 6% on tribal lands, 7% on USFS lands, and 1% on all other lands (MIS 2021).

APHIS-WS annually flies less than 20 min/mi^2 (this is equivalent to under two seconds per acre), on properties under agreement.

30. **We received several comments opposing the use of lead ammunition and claims that the EA failed to properly analyze the use of lead ammunition.** We disagree that the use of lead ammunition in PDM activities were not adequately analyzed in the EA. Section 3.10.2 adequately addresses the potential impacts and risk associated from the use of lead ammunition. Section 3.10.2 provides analysis of the potential impacts of lead on birds, mammals, amphibians and reptiles, fish, and soils and water. The analyses further indicated that the risk to humans of lead exposure from WS-New Mexico PDM activity is low. APHIS-WS conducted a formal, peer reviewed Risk Assessment on use of lead ammunition which can be accessed by following the link in Appendix F. The Risk Assessment found that WS limited use of lead ammunition poses minimal risk to the environment (USDA Wildlife Services 2017b). Nationwide, APHIS-WS contributes less than 0.01% of the amount of lead being introduced into the environment from hunting, fishing, and industrial activities. Studies cited by commenters suggest that lead concentration in scavenging birds and mammals is likely attributed to hunted discarded viscera of game animals (Bedrosian and Craighead 2009) WS contribution is negligible, and no cumulative effects are anticipated. Commenters provided no new information that alters the analysis of effects provided in the EA, and we feel the analysis is comprehensive and sufficient.

31. **WS-New Mexico 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 an incident in Idaho in 2017, 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. 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-44s must be used in accordance with the U.S. Environmental Protection Agency (EPA) pesticide label including the 27 Use Restrictions (revised 1/15/2020), and the Wildlife Services Implementation Guidelines. 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.

WS-New Mexico will not use any toxicants for PDM on public land as described in Senate Bill 32. This includes M-44s (sodium cyanide), LPCs (sodium fluoroacetate), and gas cartridges (sodium nitrate). This policy markedly reduces the potential for pet or human exposure (Section 3.10.3.1). Section 2.4 of the EA provides the protective measures used by WS-New Mexico to minimize the likelihood of non-target take or human exposure to M-44s. Section 3.10.3.1 provides analysis of the potential impacts and risks from the use of sodium cyanide in M-44s.

32. **The EA also fails to adequately evaluate the impacts of public lands grazing that the WS-New Mexico PDM program supports.** Impacts of public land livestock grazing is outside of the scope of this EA for several reasons. WS-New Mexico does not regulate public land livestock grazing. APHIS-WS does not have authority to require ranchers where and how ranchers graze or their livestock on private or federal land. Refer to section 1.6, 2.5.16, 2.5.19, and 3.3 of the EA for more information on this topic.

33. **General assertions were made that the proposed action would have cumulative environmental effects to populations and biodiversity. Commenters were also concerned that the EA did not consider cumulative take of the proposed action along with take by non-WS entities.** We disagree with the assertion that the EA does not take a hard look at the cumulative effects of the proposed action. We addressed cumulative effects fall all target species in Section 3.5 of the EA. This section documents and analyzes take by WS-New Mexico along with known hunter, trapper, WCO, and other harvest, as documented by the State of New Mexico. Section 3.7 of the EA described anticipated cumulative effects to non-target species while Section 3.6 described cumulative effects for federally listed species. Commenters provided no additional information that alters the cumulative effects analysis in the EA.
We addressed cumulative effects of trophic cascades and biodiversity in Section 3.8 of the EA. This analysis looked at WS-New Mexico proposed activities and the cumulative

take of species and determined that there would be no significant impacts as a result. Commenters did not provide any additional information to alter this conclusion.

34. **Commenters suggest that WS-New Mexico must include all species lethally taken by WS-New Mexico in this EA because they are all connected actions and not including them in this EA is improper segmentation.** We disagree with this claim. WS-New Mexico activities related to bird damage management, rodent damage management, feral swine damage management, and activities for other species are substantially different than PDM activities, therefore the management actions for those species are covered under separate NEPA documents.

35. **Impacts on target species:**

    The EA fails to adequately analyze the impacts of the WS-New Mexico PDM activities on target species. WS-New Mexico disagrees with this claim. Section 3.5 of the EA is a full analysis of the effects of WS-New Mexico PDM on all target species considered in the proposed action. WS-New Mexico's decision was a finding of no significant impact from the proposed action for all target species based on the analysis in the EA

    Commenters claim that the EA fails to consider PDM impacts to coyote populations and that coyote populations are self-regulating. Commenters did not provide literature to support this claim and WS is unaware of any data that demonstrate that self-regulation of coyote meets WS objectives (*e.g.*, the self-regulation of coyote lower the risk to livestock). We disagree with the claim that the EA fails to adequately consider coyote behavior and family group structure in response to PDM activities. Impacts of PDM specifically on coyote populations is discussed in Section 3.5.3 of the EA.

    The EA fails to consider the impacts of localized bear and cougar removals. We disagree that impacts in the EA should be measured at local or regional levels for the reasons discussed in Section 1.9.3 and within the impact analyses for individual target predator populations in Section 3.5. The determination for the scale of the analysis is addressed section 1.9.3 of the EA. The rapid return of local populations to pre-management levels demonstrates that limited, localized actions taken to resolve a particular damage problem have minimal impacts on the target species' population as explained in section 1.10.2 and Chapter 3.5 of the EA. Our analyses of potential impacts on statewide populations in Chapter 3 indicate that this level of analysis is not warranted, because the proportion of cumulative take contributed by WS-New Mexico is low for all native predators targeted during PDM.

Commenters claim that the EA states that WS-New Mexico could kill up to 40 cougars annually. Despite this very significant potential increase in lethal management by WS-New Mexico, the EA contains no meaningful analysis of the impact on the local ecosystem. WS-New Mexico disagrees with this claim because commenters either knowingly or unknowingly fail to understand the concept of maximum anticipated take. This concept is thoroughly discussed in section 3.5.1 of the EA. The WS annual maximum anticipated take 40 cougars is represented as the most WS-New Mexico could take in a given year under the current program/proposed action (Alternative 1) given the potential for fluctuations in program delivery (Appendix D). The projected annual cumulative take provides a conservative estimate of the highest proportion of the estimated species population that could be taken by all sources, under projected WS annual maximum anticipated take scenario. The proportion is then compared to the lowest maximum sustainable harvest level from the literature. Under no circumstances should the projected WS annual maximum anticipated take be interpreted as the target number of animals WS-New Mexico seeks to remove. WS-New Mexico average take of cougars is 3.8/year between 2015-2019 (EA Section 3.5.8). WS-New Mexico determined that PDM activities under the proposed action would not have a significant impact on cougar populations in New Mexico.

36. **Commenters claim that the EA fails to adequately analyze the impacts of WS-New Mexico's PDM activities on nontarget species.** WS-New Mexico disagrees with this claim. Section 3.7 of the EA is a full analysis of the effects of WS-New Mexico's PDM activities on nontarget species. The total unintentional lethal take during these years was just 1.23% of the total PDM lethal take indicating that the methods and procedures used are highly selective for target species WS-New Mexico's decision was a finding of no significant impact from the proposed action.

37. **Commenters claim the WS-New Mexico fails to consider PDM impacts on migratory birds protected under the MBTA. WS-New Mexico disagrees with this claim. This topic is adequately addressed in section 1.8.3 of the EA.** APHIS-WS and the USFWS recognize that non-target migratory birds might incidentally be killed despite the implementation of all reasonable measures to minimize the likelihood of take during actions covered under depredation permits, depredation and control orders, and agricultural control and eradication actions. WS-New Mexico consults with the USFWS on potential impacts to migratory birds an implements protective measures to reduce the risk of taking migratory birds during PDM activities.

38. **Commenters claim that the EA fails to adequately analyze the impacts of the WS- New Mexico PDM activities on threatened and endangered (T&E) species.** WS-New Mexico disagrees with this claim. Section 3.6 of the EA is a full analysis of the potential impacts

of WS-New Mexico's PDM activities on T&E species. WS-New Mexico did not take any T&E species between FY15 to FY19 while conducing PDM activities in New Mexico. WS-New Mexico follows all reasonable and prudent measures and terms and conditions required in the December 16, 2014 Section 7 concurrence letter from USFWS (EA Sections 2.4.1.17, 2.4.2.1, 2.4.2.2, WS Directive 2.310).The potential impacts of WS-New Mexico's PDM activities 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 for the proposed action based on the analysis in the EA.

39. **Commenters claim that WS-New Mexico must prepare an EIS because the program is likely to adversely affect ESA listed species or its habitat 40 C.F.R. § 1508.27(b)(7) or may result in incidental take of ESA listed species 40 C.F.R. § 1508.27(b)(10).** WS-New Mexico disagrees with this claim. WS-New Mexico takes many precautions to minimize the likelihood of taking non-target animals, including threatened or endangered species listed in table 1.4.2.1 and Section 3.6 of the EA: (1) WS-New Mexico employs a variety of protective measures, as discussed in Section 2.4; (2) WS-New Mexico consults with the USFWS, as discussed in Section 1.8.3 and 3.6 in order to minimize the likelihood of impact to any threatened or endangered species; (3) WS-New Mexico conducts NEPA analyses, such as this EA, to ensure that our activities will not negatively impact non-targets, including threatened or endangered species; (4) WS-New Mexico works with state and federal land managers, as discussed in Section 1.7 and 1.8, to ensure that our activities will not damage any critical habitat, or otherwise affect any threatened or endangered species on the lands they manage; (5) WS-New Mexico works with NMDGF, as discussed in Section 1.7 to ensure that state-listed species are protected; and (6) WS-New Mexico follows federal, state, and local laws, including those intended to protect listed species.

    Commenters claim the WS-New Mexico fails to comply with the ESA to address incidental take of listed species. This is a false claim. WS-New Mexico's policies for reporting incidental take to the USFWS and measures to reduce incidental take for listed species are thoroughly discussed throughout section 2.4 and 3.6 of the EA.

40. **Commenters claim that formal consultation was required for Canada lynx, effects determinations for Canada Lynx are misleading, claim that Likely to Adversely Affect (LAA) determinations warrant preparation of an EIS, new information may be available that warrants re-initiation of consultation, and that WS-New Mexico fails to analyze potential impacts to Canada lynx.** These claims by the commenters are not true. First, WS-New Mexico was not required do a formal consultation with the USFWS on impacts Canada lynx. WS-New Mexico adopted protective measures from the

Formal WS-Colorado consultation on Canada Lynx. Second, the determination given to WS-New Mexico on impacts to Canada lynx in New Mexico is "May Affect Not Likely to Adversely Affect" (MANLA), not LAA (USFWS 2014 Concurrence Letter). Third, as stated in section 3.6.4.15 of the EA; based on the low frequency of lynx occurrence in New Mexico and implementation of the listed conservation measures, the USFWS believes the effects of WS activities on the lynx are insignificant and discountable. These conservation measures assure that certain activities will not be conducted within lynx habitat and the USFWS does not anticipate that any lynx will be harmed or harasses as a part of WS-New Mexico activities (USFWS 2014 Concurrence Letter). The USFWS concurs that WS activities may affect but are not likely to adversely affect the lynx. Fourth, commenters did not provide any new information on impacts to Canada lynx that warrants re-initiation. Finally, WS-New Mexico has never caught or harmed a Canada lynx while conducting PDM activities in New Mexico.

41. **Commenters claim that WS-New Mexico fails to adequately analyze potential impacts to Mexican wolves while conducting PDM. Commenters cite an incident that occurred in January 2013, when a WS-New Mexico employee accidentally shot a yearling Mexican gray wolf after mistaking it for a coyote.** WS-New Mexico disagrees that we failed to analyze potential impacts of PDM activities to Mexican wolves. In response to the 2013 incident, WS developed SOP's limiting circumstances including shooting distance and night hunting, to avoid future inadvertent take of a Mexican wolf (EA section 3.6.4.14). A detailed description of how WS-New Mexico coordinates and consults with the USFWS when conducting PDM in or near Mexican wolf habitat and conservation measures to avoid potential impacts is provided in section 3.6.4.14 of the EA). WS-New Mexico has not incidentally taken any Mexican wolves since the 2013 incident.

    Commenters claim that our consultation for Mexican wolves is outdated that WS-New Mexico must reinitiate consultation. WS-New Mexico disagrees with this claim. WS-New received confirmation from the USFWS that the determinations and the conservation measures for all T&E species covered in the USFWS 2014 Concurrence letter were still sufficient prior to posting this EA for public comments on regulatios.gov.

42. **Commenters claim that new information may be available that warrants re-initiation of consultation for PDM impacts to Jaguars.** Commenters did not provide any new information related to this claim. However, On July 22, 2021 the USFWS issued a final rule to comply with a court order to vacate Unit 6 and the New Mexico portion of Unit 5 from the March 5, 2014, final rule designating approximately 764,207 acres of land in New Mexico and Arizona as critical habitat for the jaguar (Panthera onca) under the Endangered Species Act of 1973, as amended. This final rule removes approximately

110,438 acres of land within New Mexico from the designation of critical habitat for the jaguar. This ruling removes all jaguar critical habitat in New Mexico. However, Unit 5 critical habitat remains at the Arizona/New Mexico border. For this reason, WS-New Mexico will continue to abide by the conservation measures listed in section 3.6.14.6 of the EA for all PDM activities near jaguar critical habitat.

43. **Commenters claim that WS-New Mexico must consider potential impacts from PDM to the pine marten which is considered a state threatened species in New Mexico.** WS-New Mexico has never recorded taking a pine marten during PDM activities in New Mexico. Pine martens are considered rare in New Mexico. WS-New Mexico does not conduct PDM activities in pine marten habitat described as mature forests of spruce fir, Douglas fir, and other conifers in northern New Mexico. WS-New Mexico cooperates with the NMDGF per applicable New Mexico statute and regulations, and in accordance with guidelines, restrictions, and objectives set forth by NMDGF management and conservation plans and cooperative agreements.

44. **Commenters claim that WS-New Mexico must involve the public in interagency consultations and make all ESA consultations publicly available on our website.** WS-New Mexico disagrees with this clam. The NEPA or the ESA do not require agencies to involve the public when conducting interagency consults or post interagency consults on our websites for the public to view.

45. **Commenters claim that WS-New Mexico failed to take the requisite hard look at the humanness and ethics of PDM.** We disagree with the claim that the EA fails to take a hard look at the humanness of PDM. WS-New Mexico understands that PDM may not be acceptable to some individuals based on their values and/or beliefs. The threshold triggering a request for assistance in dealing with a particular damage situation is often unique to the individual person, entity, or agency requesting assistance. Therefore, what constitutes damage to one person or entity and considered intolerable may not even be considered a problem by another individual or entity. Humaneness and Ethics of PDM methods are fully analyzed in Section 3.9 of the EA. The protective measures implemented by WS-New Mexico, as discussed in Section 2.4, and the descriptions of each individual method provided in Appendix A, provide further information on the humaneness of WS-New Mexico's implementation of PDM. Selectivity of the various methods also relates to humaneness. More selective methods are considered more humane methods because they reduce unnecessary pain and suffering in non-target animals. As discussed throughout the EA, WS-New Mexico uses the most humane and selective methods practical for each predator damage situation. WS-New Mexico personnel are skilled professionals who abide by applicable laws, WS-Directives, and regulations for trap use and all other PDM methods proposed by WS-New Mexico.

Additionally, WS-New Mexico personnel abide by the species-specific AFWA Trapping BMPs, which were most recently updated in 2020 (White et al 2020)
No new information was provided that altered the analysis presented on PDM impact to Humaneness and Ethics.

A commenter questioned the humaneness of enclosed foothold traps also referred to as dog-proof traps or EGG traps. One commenter stated that we did not adequately consider the humanness of enclosed foot-hold traps, also citing Hubert et al 1996. We evaluated enclosed foot-hold traps in the Risk Assessment for foothold traps and the 2020 update to the AFWA BMPS, both reviewed and cited in the EA. We also reviewed Hubert et al (1996), which found the EGG trap ™ to be more humane than coil spring traps. It also reduced the severity of trap-related injuries and self-mutilation. The study also cited the Proulx et al (1993) conclusion that the EGG trap was humane. We feel these citations support the analysis and the inclusion of this method in the proposed integrated PDM program.

One commenter stated that the EA fails to consider sublethal CO dose in burrows.WS-New Mexico applies gas cartridges in accordance with label directions which were developed under the direction and certification of the EPA to be humane and safe. The use of carbon monoxide was analyzed in the Risk Assessment (USDA 2019g), which was part of the analysis for the EA.

A commenter wants to know how often WS-New Mexico repairs and inspects padded foot traps. Traps are inspected and repaired every time they are set and re-evaluated during trap checks.

A commented suggested that WS-New Mexico use trap monitors to increase humaneness. WS-New Mexico does use trap monitors where they are practical and where there is cell coverage. We are also developing telemetry-based monitoring devices, in conjunction with NWRC, and will continue to explore the uses of these devices to increase effectiveness and humaneness of PDM activities.

Commenters oppose the use of M-44s and Large Gas Cartridges due to the poisonous chemicals they contain. We understand that some individuals will disagree with some PDM methods. Section 2.4 provides the protective measures used by WS-New Mexico to minimize the likelihood of non-target take or human or pet exposure. These methods are discussed in Appendix A and WS formal Risk Assessments Appendix F. Humaneness of theses methods is fully discussed in section 3.9 of the EA.

Commenters claim that traps and snares are indiscriminate and inhumane. We disagree with this claim. WS-New Mexico might use several types of traps for PDM actions, as stated in Appendix A. The potential for traps and snares to impact non-target animals, threatened and endangered species, human and pet safety, public lands, and wilderness areas was included in our analyses in throughout chapter 3 of the EA. Protective measures for the use of traps and snares by WS-New Mexico are included in Section 2.11. Much research has been conducted since the 1990's on traps and snares to make them more humane to animals, more efficient at catching wild animals, more effective, more selective at catching target animals and avoiding non-target animals, and lastly to make traps more safe and humane. This process is discussed in the EA at Section 3.9. APHIS-WS NWRC is constantly working to develop and test new lethal and non-lethal methods for predators. APHIS-WS and WS-New Mexico field personnel are highly experienced and trained in use and deployment of methods to increase effectiveness and selectivity (Sections 3.7 and 3.9).

Commenters suggest that we must take into consideration the findings of Rochlitz et al. 2010, snares on animal welfare report. WS-New Mexico reviewed the report and concluded that it is an opinion piece that does not take into consideration the trap modifications and protective measures that WS-New Mexico employs when using snares for PDM. Therefore, the claims in Rochlitz et al 2010 do not add any substantive information to the analysis in the EA. WS formal Risk Assessment (2017) on use of cable restraints found them to be effective and humane.

46. **Commenters claim that the EA fails to describe the significant risks public safety created by its PDM activities.** WS-New Mexico disagrees with this statement. Impacts on the environment and risk to humans and domestic animal health and safety for all proposed PDM methods and activities, including aerial shooting are fully analyzed in section 3.10 of the EA. Each subsection in 3.10 references the Risk Assessments for each method as they are cited in the EA. WS formal risk assessments for the proposed methods in Appendix A found the risk to be minimal.

47. **Commenters claim that WS-Mexico fails to properly analyze PDM impacts to recreation in New Mexico.** We disagree with the claim that the EA fails to provide a detailed analysis of the impact PDM activities have on recreation. Impacts to recreation are considered throughout chapter 3 and specifically section 3.10. Potential Impacts to the public, including recreationist and hunters are considered for all PDM methods in chapter 3 including the use of firearms, traps, aerial shooting and low-level flights, lead ammunition, and toxicants. The EA also addresses many sociocultural aspects and potential impacts such as aesthetics, impacts to recreation areas, economic concerns, and the value of wildlife in Sections 1.4, 1.13, and 3.11. The analysis showed that PDM activities, as proposed in Alternative 1 are safe and unlikely to have any significant effect on the human environment, including public lands and the recreational experience.

48. **Commenter claim that the EA also fully disregards testimony on Senate Bill 32 in the New Mexico legislature.** Testimony on Senate bill 32 is outside of the scope of this EA. The decisions related to Senate bill 32 are made at the state level in New Mexico. New Mexico Senate Bill 32 was signed into law on April 7, 2021. WS-New Mexico will abide by the policies outlined in Senate Bill 32 (section 2.4.4.7) regarding PDM activities on public land in New Mexico. Section 2.4.3.4 of the EA outlines the policies WS-New Mexico will implement to comply with senate bill 32. WS-New Mexico's implementation of these operating policies will go into effect when the decision document is signed for this EA, or no later than the Senate Bill 32 deadline of April 1, 2022.

49. **Commenters claim that WS-New Mexico's proposal to conduct PDM in congressionally designated Wilderness Areas contravenes the Wilderness Act and fails to consider impacts to Special Areas including Wilderness Areas, Wilderness Study Areas, and Areas of Critical Environmental Concern.** We disagree with the claim that PDM activities on Wilderness Areas and Wilderness Study areas will result in significant environmental effects or establish precedent for future actions with significant environmental effects. Unlike in *WWP v. APHIS-WS* (320 F. Supp. 3d), WS-New Mexico sufficiently addressed other agencies concerns in preparation of this EA. WS-New Mexico also maintains consistency with agency land management plans (Section 1.8) and thoroughly considers impacts of PDM activities in special management areas in section 3.11 of the EA. WS-New Mexico abides by all federal and state laws, regulations, and policies set forth for special management areas as stated in Section 3.11.1 and Appendix B of the EA.

50. **One commenter cited OIG Audits from 2004, 2005, and 2006 which stated that APHIS-WS was not in compliance with the Bioterrorism Preparedness and Response Act.** Between 2002 and 2006, there was one (1) OIG audit involving WS, which resulted in an audit report (OIG 2004, WS hazardous materials issues). Additionally, APHIS-WS has proactively conducted reviews and audits of the Pocatello Supply Depot and NWRC facilities. As of April 30, 2007, all corrective actions for the audit were completed, and the USDA Office of the Chief Financial Officer (OCFO) assigned closure dates for each recommendation. APHIS-WS has implemented a comprehensive inventory accounting system (CMITS) for hazardous materials and controlled drugs that APHIS WS uses in wildlife damage management and has updated and strengthened its management Directives pertaining to pesticides and hazardous materials. APHIS-WS answered the OIG recommendations related to storage by updating the management directives containing the requirements for proper storage and security of hazardous materials. All audit recommendations were satisfied and closed during 2007.

The 2005 and 2006 OIG audit reports did not involve APHIS-WS. The audit report entitled, “Animal and Plant Health Inspection Service Evaluation of the Implementation of the Select Agent or Toxin Regulations Phase I (Report No: 33601-02-AT)” for 2005 involved APHIS Veterinary Services and Plant Protection and Quarantine programs. The audit report entitled, “Animal and Plant Health Inspection Service Evaluation of the Implementation of the Select Agent or Toxin Regulations Phase II (Report No: 33601-3-AT)” for 2006 involved APHIS Veterinary Services and Plant Protection and Quarantine programs. This audit is closed.
This report and the issues associated with it were rectified over a decade ago and there have been no bioterrorism incidents resulting from APHIS-WS activities. This audit occurred and the process was concluded over a decade ago. This has no bearing on the analysis in the EA.

51. **One commenter claimed that WS-New Mexico misinterprets the findings of an OIG audit in 2018.** This is an incorrect statement, as there was no OIG audit of APHIS-WS in 2018. There is an OIG Final Action Verification Report released September 2018 that was a follow up to the 2015 audit. OIG found stated:

    We determined that APHIS provided sufficient documentation to OCFO to close the seven recommendations we made in our September 8, 2015 audit report, APHIS Wildlife Services—Wildlife Damage Management. The following table summarizes the action APHIS took with respect to each recommendation.

    This report is not “new information” nor does it contain revelations of agency failings, as claimed by the commenter. The report can be viewed at https://www.usda.gov/sites/default/files/33026-0001-41.pdf

52. **Commenters claim that public attitudes have shifted dramatically in recent times and that killing native wildlife – a public trust resource – especially on publicly owned lands, for the perceived economic benefit of a handful of private livestock producers, fails the government’s public trust obligations (Treves et al 2017).** Treves et al. (2017) discuss the public trust principle, that democratic governments must preserve environmental components (e.g., predators) as assets held in trust for current and future generations. The authors identify what they perceive as challenges to meeting public trust responsibilities as they pertain to predators including challenges to agency good-faith action as a trustee for all uses and values of predators instead of advocacy for a particular perspective (e.g., agency capture). Other challenges identified include discussion of the limits of current information on predator biology including information on sustainable harvest, and the efficacy of access to lethal methods in changing public attitudes towards predators. Treves et al. (2017) recommend the establishment of

neutral trustees who take a broad public interest approach to allocating environmental assets for current and future generations. Decisions regarding management of public trust resources would be guided by science. Many of the issues addressed by (Treves et al. 2017) are outside the scope of this EA (e.g., appointment of public trustees for natural resources, the role of agencies, courts and regulations in framing predator management policy). Other issues, such as the role of lethal methods for predator management in changing public attitudes are addressed herein.

As stated in Section 1.13.6.1, because wildlife belongs to the American public, it is national policy that some of the resolution of damage caused by those same species is also publicly supported. Within the constraints of WS-New Mexico decision-making, we believe that the proposed EA works in good faith to preserve predator populations and their role in ecosystems for current and future generations. WS-New Mexico also consults extensively with state and federal agencies to ensure consistency with their land management plans, which is explained in Sections 1.7, 1.8. WS-New Mexico monitoring of program actions will help to ensure that new information on predator biology, the role of predators in ecosystems, efficacy of nonlethal and lethal PDM methods, and the human dimensions of predator management are considered and included in program decision-making, as appropriate.

53. **Commenters claim that the EA fails to address whether the proposed action is consistent with other governing federal land management Plans. WS-New Mexico disagrees with this claim.** Section 1.8 of the EA fully explains how WS-New Mexico works with federal agencies and how WS-New Mexico works on federally managed lands. Work plans for PDM on federal lands are developed with the federal land management agency to ensure actions comply and align with their policies and plans.

54. **Commenter claim that the EA's analysis of PDM impacts climate change is insufficient.** WS-New Mexico disagrees with this claim. Potential impacts of PDM related to climate change are discussed in section 3.3 and the relationship of climate change to predator population dynamics is adequately addressed in section 3.5.2 of the EA.

5.2 Documents Already Incorporated and Cited in the EA.

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

AFWA BMPs Striped Skunks	Musiani et al 2005
Berger and Gese 2007	OIG 2018 APHIS audit report
Bergstrom et al 2014	Painter et al 2015
Beschta and Ripple 2010	Phillips 1996, evaluation of 3 types of snares
Beschta and Ripple 2011	Prugh et al 2009
Beschta and Ripple 2012	Ripple et al 2013
Bradley et al 2015	Ripple et al 2014, trophic cascades
Brook et al 2012	Ripple et al 2015
Callen et al 2013	Shivik et al 2013
Cruz-Martinez et al 2012	Shivik et al 2014
Eklund et al 2017, effectiveness of PDM for livestock	Teichman et al 2016
Estes et al 2011	Treves et al 2015
Guthery and Beasom 1978, selectivity of snares	Treves et al 2017, wolf poaching the US
Hebblewhite et al 2005	USDA Wildlife Services 2019a
Iossa et al 2007	USDA Wildlife Services 2019b
Jaeger 2004	van Eeden et al 2018a, effectiveness of PDM
Kauffman et al 2010	van Eeden et al 2018b, effectiveness of PDM
Khorozyan and Waltert 2020, anti-bear interventions	Waser et al 2014
Knowlton et al 1999	Wielgus and Peebles 2014
Miller et al 2016, effectiveness of PDM	

5.3 Documents Considered but not Cited in the EA.

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

2020 Federal allocation to USDA WS	Knudson 2012a, newspaper, the killing agency
ABQ Journal 2019	Knudson 2012b, newspaper, wildlife services deadly force
ABQ Journal 2019, predators	Kompaniyets and Evans 2017 wolf depredation

ABQ Journal 2020, traps	Kramer and Redig 1997, lead poisoning in eagles
Allen et al 1987, coyote composition	Laundre et al 2001, landscape of Yellowstone
APHIS Fact sheet Bald Eagles and Lead Poisoning	Lennox 2018, efficacy of predator removal
Bedrosian et al 2012 Lead exposure in bald eagles	Leopold et al 1964, predator and rodent control
Bedrosian et al 2012, lead exposure	Liebezeit et al 2014 lead in scavengers
Belsky and Gelbard 2000, livestock grazing	Lute 2021 trap-free New Mexico
Bergstrom 2017, Carnivore conservation	M44 photos Torrance county
Beschta 2003, trophic cascades	Manfredo et al 2009, wildlife value
Beschta 2005, trophic cascades	Manning et al 2009, landscapes of fear
Beschta and Riple 2006, 2007, 2008, 2009, 2010, 2012, 2013, 2015, 2016, and 2017, trophic cascades	Marshal 2015, human injuries in snares
Beschta et al 2016, trophic cascades	Mateo et al 2003 lead in bones of birds
Beschta et al 2018, trophic cascades	Mattson et al 1991, grizzly bear food habits
Best et al 1992a, lead exposure	Mertes 2019, 2021 trapping will damage tourism
Best et al 1992b, lead exposure	Middletone et al 2013, risk effects of carnivore hunting
Boronyak 2020, large carnivore coexistence	Miller et al 1998, blood lead levels in bald eagles
Bouchard et al 2013	Miller et al 2001, lead in bald eagles
Brand and Nel 1997	Moreira-Arce et al 2018, effectiveness of PDM
Brown et al 1999	Neumann 2009, lead poisoning in bald eagles
Browne-Nunez et al 2015	Nino 2020 NM trapping laws
Burskotter and Wilson	NM SB 32 2022
Cart 2014, newspaper	NMDGF, Coyote wildlife note
Carter et al 2019, human-wildlife coexistance	O'neill 2007, monitoring traps with mobile phone
Church et al 2006, lead accumulation in California condors	Painter et al 2012, trophic cascade
Cooley 2009, compensatory mortality hypothesis	Pattee et al 1990, lead hazards to condor
Cooley et al 2009, source populations in carnivore management	Peebles et al 2013, effects of hunting on cougar complaints
Creel and Christianson 2009	Pepper et al 2003, effects of aircraft noise

Dario Moreiro-Arce 2018	Proulx and Barrett 1994, ethical concerns of traps
Davidson-Nelson and Gehring 2010	Ramp and Beckoff 2015, ethics
Depredation Compensation Guidelines 2016	Ripple 2010, 2014, 2015, trophic cascades
Doherty et al 2014, conservation actions to demography	Ripple and Beschta 2003, wolves in Yellowstone
Domenech and Langler 2009, lead levels in eagles	Ripple and Beschta 2004, predation risk
Edvenson 1994	Ripple and Beschta 2005, wolf reintroduction
Fedy and Aldridge 2011	Ripple and Beschta 2006, 2012, trophic cascades
Franson and Russell 2014, lead and eagles	Rochlitz 2010, impact of snares on animal welfare
Franson et al 2009, lead in doves	Rogers et al 2009, lead ingestion by scavengers
Friend 1999, lead exposure	Russell 2014, dog deaths
Gangoso et al 2009, lead in vultures	Ruth 2014, deer social structure
Giampiero et al 2019, livestock and climate change	Rutledge et al 2010, wolf pack social structure
Goncharov et al 2006, toxicology of fluoroacetate	Santiago-Avila et al 2018, wolf management
Halofsky and Ripple 2008, elk reintroduction to Yellowstone	Sasse 2003, job related mortality
Harrison 2020 leghold trap injuries to wildlife	Schulz et al 2002, spent shot in dove habitat
Hawk Watch Int. 2010, golden eagle survey	Schulz et al 2006, lead toxicosis in mourning doves
Hiller et al 2015, cougar mortalities and livestock	Schulz et al 2009, lead toxicosis in doves
Hubert et al 1996, evaluation of two traps	Senate Bill 32 fact sheet
Humane Society WS Poison Incident sheet	Shivik and Gruver 2002 animal attendance at trap sites
Hunt et al 1996, lead exposure in deer	Smith et al 2003, wolf management
Husseman 2002, prey selection patterns	Smith et al 2015, increased kill rate
Husseman et al 2003, differential prey selection	Squires et al 2013, predicting corridors for Canada lynx
Imbert et al 2006, wolf diet	Suraci et al 2016, trophic cascade
Keefover 2009, war on wildlife	USDA 2017 Cattle loss

Keel et al 2002, lead in quail	Verzuh et al 2018, intercanine width in predation investigations
Kendall and Scanlon 1979, lead in mourning doves	WEG 2020, trapping report
Kendall et al 1996, lead exposure in upland birds	White 2012, trophic cascades
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Chapter 6 LIST OF AGENCIES CONSULTED

- United States Fish and Wildlife Service
- United States Forest Service
- New Mexico Department of Agriculture
- New Mexico Depart of Game and Fish

Chapter 7. LIST OF PREPARERS

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

Introduction

WS-New Mexico 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-New Mexico 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-New Mexico program. See Section 3.9 for a detailed discussion on humaneness of various IPDM methods.

What Non-Lethal IPDM Methods Are Available to WS-New Mexico?

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-New Mexico 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-New Mexico employee may implement it. Livestock producers and property owners are encouraged by WS-New Mexico 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 PDM activities and facilitates coexistence between people and wildlife. In addition to providing recommendations and information to entities experiencing damage, APHIS-WS provides lectures, courses, 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 can reduce coyote predation. All technical assistance regarding guard dogs is conducted in compliance with WS Directive 2.440 (Section 2.4.1.13).

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-New Mexico only provides advice on the type of modifications that have the best chance of achieving the desired effect. WS-New Mexico advises landowners/managers that they are responsible for compliance with all applicable regulations related to habitat management, including the Endangered Species Act.

Architectural design can often help to avoid potential predator damage. For example, incorporating open areas into landscape designs that expose animals may significantly reduce potential problems. Additionally, selecting species of trees and shrubs that are not attractive to wildlife can reduce the likelihood of potential predator damage to parks, public spaces, or residential areas.

Managing the habitat, such as minimizing cover, planting lure crops, and tree removal, can sometimes reduce damage associated with predators that use vegetation and crops for foraging and hiding. Habitat management is a primary strategy at airports to reduce aircraft damage and protect human safety. Generally, many problems associated with predator 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 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-New Mexico employees receive safety training in transporting, using, and storing pyrotechnics, as required by WS Directives 2.615 and 2.625 (Section 2.4.1.3, 2.4.1.4). When pyrotechnics are recommended during technical assistance, WS-New Mexico 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-New Mexico and NMDGF 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 policies are provided in WS Directive 2.620 (https://www.aphis.usda.gov/wildlife_damage/directives/pdf/2.620.pdf, Section 2.4.1.11) 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

NMDGF generally does not authorize the relocation of problem predators because of the high risk of moving the problem along with the problem animal, but WS may assist NMDGF per WS Directive 2.501 (Section 2.4.1.7). 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 PDM Methods That May be Either Lethal or Non-Lethal Are Available to WS-New Mexico?

WS-New Mexico 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-New Mexico 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.

It is illegal to place, set, or maintain any steel trap or snare with visible bait consisting of flesh, hide, fur, viscera, or feathers, but bones that are entirely free of flesh, hide or fur may be used as visible bait. APHIS-WS Policy (WS Directive 2.450, Section 2.4.1.2) states that the use of the BMP trapping guidelines developed by AFWA would be followed as practical. APHIS-WS policies and New Mexico state laws for using traps and snares are listed in Section 2.4.4.3. Most of these methods can also be used by NMDGF, 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 NMDGF.

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 only authorized for use on private land, 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 and New Mexico state legislation prohibits the use of any killing trap having a jaw spread greater than 7 inches in a land set on public lands, or greater than 7.5 inches inside jaw spread used in making a water set except when authorized by the NMDGF. Quick kill traps are available to all entities for use on private land in New Mexico. New Mexico Senate Bill 32 outlaws the use of quick-kill traps on public land, effective April 1, 2022.

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).

Foothold traps set for coyotes, 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-New Mexico follows state law (Section 2.4.4) and regulations regarding the setting and checking of traps and snares as follows per APHIS-WS Directive 2.450 and 2.210 (Sections 2.4.1.2).

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-New Mexico 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 2.4.1.2, 2.4.1.1).

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.

Snares offer several advantages over foothold traps by being lighter to transport or carry and not being as affected by inclement weather.

In general, cable restraints are available to all entities for use on private land in New Mexico. New Mexico Senate Bill 32 outlaws the use of snares on public land, effective April 1, 2022.

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-New Mexico 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-New Mexico and other certified entities.

Trained pursuit dogs are used by NMDGF (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 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 PDM Methods Are Available to WS-New Mexico?

Aerial Shooting: Technical Assistance or Operational Assistance

Aircraft, both fixed-wing and rotary-wing (helicopters) are primarily used by WS-New Mexico for removing coyotes or feral swine. The most frequent aircraft used for aerial shooting and harassment is the fixed-wing aircraft Piper PA-18 Super Cub ad CubCrafters CC-18 Top Cub and rotary-wing Hughes MD500. WS-New Mexico conducts aerial activities on areas only under agreement or federal Annual Work Plans, and concentrates efforts to specific areas during certain times of the year. During technical assistance, WS-New Mexico may advise cooperators to hire private operators with an NMDGF permit for aerial shooting of coyotes. Additionally, WS-New Mexico may conduct the work operationally at the request of cooperators.

Aerial shooting consists of visually sighting target animals in the problem area and shooting them with a firearm from an aircraft. Aerial shooting is species-specific and can be used for immediate damage relief, providing that weather, topography and ground cover conditions are favorable. Aerial shooting can be effective in removing offending animals that have become trap-shy or are not susceptible to calling and shooting or other methods. This method may also be used proactively to reduce local coyote predations in lambing and calving areas with a history of predation.

Fixed-wing aircraft are useful for aerial shooting over flat and gently rolling terrain. Because of their maneuverability, helicopters have greater utility and are safer over timbered areas or broken land where animals are more difficult to spot. Aerial shooting typically occurs in remote areas with low densities of tree or vegetation cover, where the aerial visibility of target animals is greatest. WS-New Mexico spends relatively little time flying and shooting over any one area.

The APHIS-WS program aircraft-use policies help ensure that aerial shooting is conducted in a safe and environmentally sound manner, in accordance with federal and state laws. State Directors and Program Managers are responsible for the supervision, management, and compliance for all aviation activities within the state, and all aircraft used by WS-New Mexico 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 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-New Mexico 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-New Mexico 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,). The use and possession of firearms must be in accordance with federal, state, and local laws and regulations (also WS Directive 2.210). APHIS-WS personnel must adhere to all safety standards of firearm operation as described in the APHIS-WS Firearms Safety Training Manual. Such personnel are subject to drug testing when considered for hire, randomly, when under reasonable suspicion, and after accidents have occurred. All employees who are use firearms are subject to the Lautenburg Domestic Confiscation Law, which prohibits firearm possession by anyone convicted of a misdemeanor crime or domestic violence. WS-New Mexico complies with state laws, statutes, and NMDGF 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.

NMDGF, 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-New Mexico disposes of carcasses according to WS Directives 2.515 and 2.510 (Section 2.4) and New Mexico state law and regulations (Section 2.4). Predator carcasses are disposed of in approved carcass disposal sites on public or private lands or on-site where captured. WS-New Mexico does not bury predator carcasses.

What Lethal and Non-lethal Chemical Methods are Available to WS-New Mexico?

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-New Mexico 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 (See Section 3.9.5.1 of this EA). Denning is highly selective for the target species responsible for damage. Den hunting for coyotes and red foxes is often combined with other damage management activities such as aerial shooting and ground shooting.

Gas cartridges are normally applied in rural settings. 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-New Mexico 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 2.4). The gas cartridges used for denning (EPA Reg. No. 56228-21, EPA Reg. No. 56228-2) are registered by WS-New Mexico with NMDA. All pesticides used by WS-New Mexico are registered under the FIFRA and administered by EPA and NMDA. All WS-New Mexico personnel who apply restricted-use pesticides are state-certified pesticide applicators and have specific training by WS-New Mexico for pesticide application per WS Directive 2.465 (Section 2.4).

Senate Bill 32 outlaws the use of gas cartridges on public land in New Mexico.

What Tranquilizer and Immobilization Methods are Available to WS-New Mexico?

Tranquilizer and immobilization chemicals may be used by WS-New Mexico 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-New Mexico 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) 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-New Mexico prefers to use Telazol™ for most of the species that are immobilized.

What Euthanasia Methods are Available to WS-New Mexico?

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). 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-New Mexico 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-New Mexico and are under the jurisdiction of FDA and/or DEA. WS-New Mexico 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).

Potassium chloride, a common laboratory salt, is intravenously injected as a euthanizing agent after an animal has been anesthetized (WS Directive 2.430).

Carbon dioxide (CO_2) gas is a colorless, odorless, non-combustible gas approved by the AVMA as a euthanasia method. CO_2 is a common euthanasia agent because of its ease of use, safety, and ability to euthanize many animals in a short time span. The advantages for using CO_2 are: 1) the rapid depressant, analgesic, and anesthetic effects of CO_2 are well established, 2) CO_2 is readily available and can be purchased in compressed gas cylinders, 3) CO_2 is inexpensive, non-flammable, non-explosive, and poses minimal hazard to personnel when used with properly designed equipment, and 4) CO_2 does not result in accumulation of tissue residues. Inhalation of CO_2 at a concentration of 7.5% increases the pain threshold and higher concentrations of CO_2 have a rapid anesthetic effect.

WS-New Mexico 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-New Mexico?

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.

M-44 Sodium cyanide:

Sodium cyanide is a registered pesticide available for PDM in New Mexico (EPA Reg. No. 56228-15). This pesticide can only be used by certified WS-New Mexico personnel, and therefore is only available during operational assistance. The use of M-44s for IPDM activities occur in rural settings on private property only; New Mexico Senate Bill 32 outlawed the use of lethal toxicants on public land in New Mexico, effective April 1, 2022. Use of M-44s on private or sovereign tribal lands in New Mexico must be agreed upon by the landowner.

Sodium cyanide is the active ingredient in the M-44, a spring-activated ejector device developed specifically for lethal removal of coyotes, and, to a substantially lesser degree, other canine predators. The M-44 device consists of a capsule holder wrapped with fur, cloth, or wool; a capsule containing 0.8 gram of powdered sodium cyanide; an ejector mechanism; and a 5- to 7-inch hollow stake. The hollow stake is driven into the ground, the ejector unit is set and placed in the stake, and the capsule holder containing the cyanide capsule is screwed onto the ejector unit. A rotten meat bait is spread on the capsule holder.

An animal attracted by the bait will try to pick up or pull the baited capsule holder. When the M-44 is pulled, a spring-activated plunger propels sodium cyanide directly into the animal's mouth. Generally, death from respiratory arrest is immediate. The M-44 is generally selective for canids because of the attractants used and their feeding behavior. When properly used, the M-44 presents little risk to humans and the environment and provides an additional tool to reduce predator damage.

Sodium cyanide is highly toxic to all species, including humans. WS-New Mexico use a face shield and PPE when handling M-44s and are required to keep a card with medical instructions on how to respond and treat a case of accidental exposure to sodium cyanide. APHIS-WS personnel that use the M-44 must be certified by the NMDA since it is a restricted-use pesticide. WS-New

Mexico personnel always follow the EPA's label of 27 use restrictions and WS Directives 2.401 and 2.415 (Section 2.4.1.5, 2.4.1.6). 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.

Compound 1080 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-New Mexico use of the LPC follows EPA registration and NMDA and NMDGF requirements, and is restricted to specially trained and certified WS-New Mexico employees.

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.

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Appendix B. Federal Laws and Executive Orders Relevant to WS-New Mexico Actions

Federal Laws

For relevant state laws, see Section 2.4.4 of this EA.

National Environmental Policy Act (NEPA)

Most federal actions are subject to the NEPA (Public Law 9-190, 42 USC 4321 et seq.). When APHIS-WS enters into an agreement to assist another federal agency to manage wildlife damage hazards, the other federal agency must also comply with NEPA. APHIS-WS policy is to work together for compliance. NEPA requires federal agencies to incorporate environmental planning into federal agency actions and decision-making processes. The two primary objectives of the NEPA are: 1) agencies must have available and fully consider detailed information regarding environmental effects of federal actions and 2) agencies must make information regarding environmental effects available to interested persons and agencies before decisions are made and before actions are taken.

APHIS-WS complies with CEQ regulations implementing the NEPA (40 CFR 1500 - 1508) along with USDA (7 CFR 1b) and APHIS Implementing Guidelines (7 CFR 372) as part of the decision-making process. Pursuant to the NEPA and CEQ regulations, WS NEPA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions. NEPA documents are prepared by integrating as many of the natural and social sciences as relevant to the decisions, based on the potential effects of the proposed actions. The direct, indirect, and cumulative impacts of the proposed action are analyzed.

Pursuant to the NEPA and CEQ regulations, WS NEPA documents the analyses resulting from proposed federal actions, informs decision-makers and the public of reasonable alternatives capable of avoiding or minimizing adverse impacts, and serves as a decision-aiding mechanism to ensure that the policies and goals of the NEPA are infused into federal agency actions.

Endangered Species Act

Under the ESA (16 United States Code (U.S.C.) 1531 et seq., Endangered Species Act (ESA) of 1973, as amended; 16 U.S.C. 703-712), all federal agencies will seek to conserve threatened and endangered species and will utilize their authorities in furtherance of the purposes of the Act (Sec. 2(c)). WS conducts Section 7 consultations with the United States Fish and Wildlife Service (USFWS) to use the expertise of the USFWS to ensure that "any action authorized, funded or carried out by such an agency…is not likely to jeopardize the continued existence of any endangered or threatened species…Each agency will use the best scientific and commercial data available" (Sec.7 (a)(2)).   Depending on the species, the US Fish and Wildlife Service (USFWS) and the NOAA National Marine Fisheries Service (NMFS) are charged with implementation and enforcement of the Endangered Species Act of 1973, as amended and with developing recovery plans for listed species. Under the authority of the ESA, the USFWS acts to prevent the extinction of plant and animal species. It does this by identifying species at risk of extinction, designating ("listing") these species as threatened or endangered, providing protection for these species and their habitats, developing and implementing recovery plans to improve their status, and ultimately "delisting" these species and returning full management authority to the states and tribes. While a species is listed, most management authority for the species rests with the USFWS/NMFS. However, the agencies continue to work with other Federal agencies, states, and tribes along with private landowners to protect and recover the species. The USFWS helps ensure protection of listed species through consultations (section 7 of the ESA) with other Federal agencies. Under section 10 of the ESA, the USFWS also issues permits which provide exceptions to the prohibitions established by other parts of the Act. These permits provide for conducting various activities including scientific research, enhancement of propagation or survival, and incidental take while minimizing potential harm to the species. For species federally classified as threatened, the USFWS may also issue 4(d) rules which may allow for greater management flexibility for the species. The USFWS also issues grants for protection and enhancement of habitat and for research intended to improve the status of a listed species.

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

FIFRA is the primary act under which the registration of pesticides is regulated. FIFRA authorizes Federal agencies to regulate the distribution, sale, and use of pesticides to protect human health and the environment. FIFRA authorizes EPA to review and register pesticides for specified uses. EPA also has the authority to suspend or cancel the registration of a pesticide if subsequent information shows that the continued use would pose unreasonable risks.

All pesticides distributed or sold in the United States must first be registered by EPA, and then within the individual State where it is being distributed, sold, or used. The EPA registration process requires that pesticides will be properly labeled and that, if used in accordance with the label, the pesticide should not cause unreasonable harm to humans or the environment. FIFRA does not fully preempt state, tribal, or local law, therefore each entity may also further regulate pesticide use.

National Historic Preservation Act (NHPA) of 1966, as amended

The NHPA and its implementing regulations (36 CFR 800) require federal agencies to initiate the section 106 process if an agency determines that the agency's actions are undertakings as defined in Sec. 800.16(y) and, if so, whether it is a type of activity that has the potential to cause effects on historic properties. If the undertaking is a type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under section 106. The Advisory Council on Historic Preservation (ACHP) and each state's State Historic Preservation Officer (SHPO) or the tribal government Tribal Historic Preservation Officer THPO) have the primary non-regulatory jurisdiction. If an individual activity with the potential to affect historic resources is planned under an alternative selected as a result of a decision on this EA, the site-specific consultation as required by Section 106 of the NHPA would be conducted with the SHPO or THPO as necessary.

The Native American Graves and Repatriation Act of 1990

The Native American Graves Protection and Repatriation Act (Public Law 101-106, 25 USC 3001) requires federal agencies to notify the Secretary of the Department that manages the federal lands upon the discovery of Native American cultural items on federal or tribal lands. Federal agencies are to discontinue work until the agency has made a reasonable effort to protect the items and notify the proper authority.

The Wilderness Act (Public Law 88-577(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 C. Forrest Service MOU

Alan May

NM State Director

USDA/APHIS/Wildlife Services

8441 Washington St. NE Albuquerque, NM 87113

Dear Mr. May:

This letter serves as an update to a May 8, 1997 letter that was sent to Alex Lara, NM State Director, USDA APHIS-Animal Damage Control (ADC) that addressed animal damage management by APHIS-ADC in designated wilderness areas (wilderness) managed by National Forests in the Southwestern Region. The 1997 letter cited the 1993 Memorandum of Understanding (MOU) between APHIS-ADC and the USDA Forest Service (USFS). The 1993MOU has since been replaced by a 2011 MOU between APHIS-Wildlife Services (WS) and the USFS (FS Agreement No. 11-SU-11132422-151, Cooperator Agreement No. 11-7100-0329- MU).

Under the 2011 MOU, APHIS-WS is responsible for evaluating Wildlife Damage Management(WDM) needs and developing/updating WDM work plans in cooperation with USFS, and undertaking WDM activities. WDM refers to actions taken by APHIS-WS to manage indigenous and feral vertebrates causing resource damage on NFS lands. Such actions include:

1. Minimizing livestock losses due to predation by coyotes, mountain lions, and otherpredators;

2. Managing wildlife diseases;

3. Managing invasive species like feral hogs; and

4. Protecting other wildlife, plants, and habitat from damage as requested by the USFSand/or State or Federal wildlife management agencies.

APHIS-WS is also responsible under the 2011 MOU for (1) NEPA compliance for activities involving wildlife damage, invasive species, and wildlife disease management on National Forest System lands; and (2) coordination with USFS and appropriate State and local agencies and tribes in completing the NEPA process for such activities. APHIS-WS is required to notify USFS about WDM requests prior to execution ofWDM activities and also to inform USFS aboutthe results of WDM activities in a timely manner.

For its part, the USFS is committed under the 2011 MOU to cooperate with APHIS-WS asdefined under policy outlined in Forest Service Manual (FSM) 2650. Under FSM 2651.6, animal damage management in wilderness is permitted only when it conforms to FSM 2323.33c.Predator control programs conducted by APHIS-WS within wilderness require Regional Foresterapproval (FSM 2650.42 and FSM 2323.04c (6)) and are expected to remain infrequent and of low intensity. The USFS, as a cooperating agency, will provide any measures needed to ensure that animal damage management activities performed by APHIS-WS are compatible with direction in Forest Plans.

Approval is not needed for APHIS-WS personnel to access wilderness areas on foot or horsebackfor the purpose of investigating depredation situations. Approval is required for APHIS-WS to undertake control activities for a target predator or other type of depredatory animal in wilderness. This letter grants approval to APHIS-WS to initiate control of predators and other types of depredatory animals, as well as other wildlife damage control activities within wilderness when the following conditions are met:

1. Control is necessary to (a) protect federally listed threatened or endangered species, (b)protect public health and safety, or

(c) prevent serious losses of domestic livestock. Determination of serious losses will be made by APHIS-WS or the New Mexico Game and Fish Department after investigation, historical evidence, and patterns of loss show a habitual nature of kills or loss.

2. APHIS-WS personnel travel on foot or horseback to conduct control activities, and control activities do not require any of the prohibited uses listed in Section 4(c) of theWilderness Act. These prohibited uses include but are not limited to motor vehicles, motorized equipment, motorboats, aircraft, other forms of mechanical transport, and structures or installations (e.g. traps or game cameras).

3. APHIS-WS notifies the local USFS District Ranger prior to initiating any controlactivities. Ranger District personnel will notify the Forest Supervisor's office.

4. APHIS-WS has obtained any necessary permits from the appropriate State agency.

5. Once an action has been taken, APHIS-WS documents the location and justification fortaking an animal and forwards it to the Regional Forester with a copy to the local USFSDistrict Ranger. Ranger District personnel will notify the Forest Supervisor's office.

6. In human health, human safety, or livestock depredation cases where hot pursuit of a predator that began outside of wilderness but has migrated into wilderness, APHIS-WS ispermitted to continue the pursuit for up to 12 hours after entry. Entry into wilderness must be by approved means listed in condition (2) above and the use of trailing dogs andshooting are the only control methods authorized. APHIS-WS must notify the District Ranger and Regional Forester within one business day after exiting wilderness and provide documentation that includes the reason for the action, date and location of the action, copies of any permits related to the action, and number and species of animal(s) removed.

7. APHIS-WS and the USFS meet once a year to review this policy as well as all controlactivities that occurred in wilderness.

This letter does not grant approval for preventative control of any predator species in wilderness,the use of predacides in wilderness, or any of the prohibited uses outlined in Section 4(c) of the Wilderness Act. Predator control activities shall occur only when there is strong evidence that APIDS-WS is removing the offending individual(s). For use ofpredacides in wilderness,

APIDS-WS shall follow the protocol established in the USFS *Guidance for Approving Pesticide*

Use in Region 3 (available at

http://www.fs.usda.gov/lnternet/FSE DOCUMENTS/stelprd3854200.pdf). Under FSM 2323.33c, only the Regional Forester may approve Pesticide-Use Proposals (PUPs) for use of Compound 1080 livestock protection collars to control predators in wilderness areas, and this approval will only be granted on a case-by-case basis. Poison baits or sodium cyanide ejector devices (M-44s) may not be used within wilderness. The use of temporary installations may be approved by the Forest Supervisor per FSM 2323.04d, and the use of motor vehicles, motorizedequipment or mechanical transport may be approved by the Regional Forester per FSM 2326.04b, if it is demonstrated that such prohibited uses are the minimum required for the administration of the area as wilderness.

Implementation of the policy outlined in this letter is intended to help ensure interagency coordination and concurrence on WDM activities in wilderness managed by the Forest Service. While there has been recent coordination related to feral hog control in wilderness, the Southwestern Regional Office has received no reports of APIDS-WS undertaking predator control activities in wilderness in recent years. If such activities are occurring, please ensure thatyour staff forwards the appropriate documentation to the Regional Forester per item five, listed above.

If you have any further questions, please contact Steve Hattenbach, Regional Director for Rangeland Management and Acting Regional Director for Wildlife, Fish & Rare Plants, at 505-

842-3224, or Bobbi Barrera, Deputy Director for Wildlife, Fish, and Rare Plants, at 505-842- 3194.

Sincerely,

ALVIN N. JOYNER

Regional Forester

cc: R3 NM Forest Supervisors; Steve Hattenbach; Francisco Valenzuela; Bobbi Barrera; Allen White; Bjorn Fredrickson; Brian Dykstra

Appendix D. Supplemental Details for Section 3.5. Impacts on Predator Species PopulationsTable D.1. Annual average intentional take of predators by WS-New Mexico during PDM activities, FY 2015- FY 2019.

Method annual average	Coyote	Black Bear	Striped skunk	Raccoon	Cougar	Swift Fox	Badger	Bobcat	Mexican Gray Wolf	Gray Fox	Free-ranging/ Feral Dog	Spotted Skunk	Ave per yr.
Fixed Wing	564	0	0	0	0	0	0	4	0	0	0	0	**2,765/ 553**
Helicopter	253	0	0	0	0	0	0	0	0	0	0	0	**1,121/ 224**
Foot-hold Trap	304	0	3	0	2/ 0.4	1/ 0.2	6/ 1.2	19/ 3.8	0	29/ 5.8	0	0	**1,522/ 304**
Cage Trap	2	0	480	<1	0	0	0	2/ 0.4	0	7/ 1.4	0	0	**2,422/ 484.4**
Neck Snare	584	0	0	0	0	1/ 0.2	9/ 1.8	22/ 4.4	0	41/ 8.2	0	0	**2,911/ 582.2**
Foot Snare	0	1.5	0	0	7/ 1.4	0	0	0	0	0	0	0	**9/ 1.8**
Handcaught/ga-thered	<1	0	2	1	0	0	0	0	0	0	0	0	**17/ 3.4**
Padded Foot-hold Trap	1	0	0	0	0	0	0	0	0	1/ 0.2	0	0	**5/ 1**
Firearms	767	0	27	<1	10/ 2	5/ 1	2/ 0.4	24/ 4.8	1/ 0.2	8/ 1.6	0	3/ 0.6	**3,975/ 795**
M-44 Cyanide Capsule	688.6	0	0	0	0	0	0	0	0	4/ 0.8	0	0	**3,443/ 688.6**
Calling Device	4.4	0	0	0	0	0	0	0	0	0	0	0	**22/ 4.4**
Catch Pole	<1	0	<1	0	0	0	0	0	0	0	0	0	**5/ 1**
5 year total take by species	**15,515**	**2**	**2565**	**9**	**19**	**7**	**17**	**71**	**1**	**15**	**0**	**3**	**18,225**
Annual Avg. take by species	3,103	0.4	513	1.8	3.8	1.4	3.4	14.2	0.2	3	0	0.6	3,645

Methodology for Calculating WS Annual Maximum Take for Target Species Section

Methods Overview

To estimate the fluctuations in the current program and derive a WS-New Mexico annual maximum take (the most of a species that WS could foreseeably take given program fluctuations), the following procedure was used for most species. Exceptions include coyotes (due to aerial component), and stripped skunks and weasels (since there was low historic FY 2011 - FY 2015 levels of WS-New Mexico take). WS-New Mexico annual maximum take was not derived for feral and free-ranging cats and dogs, since these are not native wildlife populations. Under no circumstances should the WS annual maximum take be interpreted as the target number of animals WS-New Mexico seeks to remove, nor does APHIS-WS (or NMDGF, for that matter) have a policy of ever taking the maximum sustainable harvest proportion of the population for any species.

For all species other than the ones mentioned above, the unintentional and intentional take was looked at collectively from the MIS (2020). The collective take was broken out by county by year for the species and the highest take in any given county in any given year between FY 2015 and 2019 was selected. This number was rounded slightly to provide a buffer. This take number was then multiplied by a factor of 3, assuming that fluctuations could result in the equivalent of three times the current county with the highest level of take. This calculation was then added to a rounded annual take total for the species across all counties. The annual take total was selected from the year with the highest annual take between FY 2015 and 2019. (This method will be referred to below as the "county estimator method".)

Coyote

Since coyotes have a large portion of take by aerial methods, the WS annual maximum take were estimated using aerial and non-aerial numbers.

For ground methods, the county estimator method above is used. Chaves County had the highest coyote take between the period of review in 2016. This number was rounded to 680 coyotes. Therefore 680 coyotes multiplied by 3 results in 2,040 coyotes. This was added to the rounded estimate of all current ground work (5,000 coyotes). Therefore, WS-New Mexico expects 7,010 coyotes per year from ground work to contribute to the overall WS annual maximum take for coyotes.

Therefore, we will utilize a WS annual maximum take of 7,010 coyotes.

Black Bear

Following the county estimator method, the annual high of black bears taken statewide was 3. This was rounded to 5.

Grant county had the highest level of black bear take in FY16 which was rounded to 5 bears. This was multiplied by a factor of 3 resulting in 15 black bear.

Therefore, we will utilize a WS annual maximum take of 20 black bear.

Striped Skunk

Follows the county estimator method.

Between FY 2015 and FY 2019there was an annual high of 581 striped skunk taken statewide by WS-New Mexico in 2016. Conservatively, this was rounded to 590.

Dona Ana County had the highest level of striped skunk take between for all counties in 2016. This take was rounded to 520 striped skunk. Therefore, 520 striped skunk multiplied by a factor of 3, results in 1,560 striped skunk.

Therefore, we will utilize a WS annual maximum take of 2,150 striped skunk.

Raccoon

Follows the county estimator method.

Between FY 2015 to FY 2019 there was an annual high of 11 raccoon taken statewide by WS-New Mexico in 2012. Conservatively, this was rounded to 15.

Chaves County had the highest level of raccoon take between for all counties in 2016. This take was rounded to 10 raccoons. Therefore, 10 raccoons multiplied by a factor of 3, results in 30 raccoons.

Therefore, we will utilize a WS annual maximum take of 45 raccoons.

Cougar

Follows the county estimator method.

Between FY 2015 and FY 2019, there was an annual high of 9 cougars taken statewide by WS-New Mexico in 2017. Conservatively, this was rounded to 10.

Grant County had the highest level of cougar take for all counties in 2017. This take was rounded to 10 cougars. Therefore, 10 cougars multiplied by a factor of 3, results in 30 cougars.

Therefore, we will utilize a WS annual maximum take of 40 cougars.

Red Fox

Follows the county estimator method.

Between FY 2015 and FY 2019 there was a single red fox taken statewide by WS-New Mexico in 2016. Conservatively, this was rounded to 5.

Therefore, we will utilize a WS annual maximum take of 5 red fox.

Badger

Follows the county estimator method.

Between FY 2015 and FY 2019, there was an annual high of 15 badgers taken statewide by WS-New Mexico in 2016. Conservatively, this was rounded to 20 badgers.

Chaves County had the highest level of badger take for all counties in 2016. This take was rounded to 8 badgers. Therefore, 8 badgers multiplied by a factor of 3, results in 24 badgers.

Therefore, we will utilize a WS annual maximum take of 45 badgers.

Bobcat

Follows the county estimator method.

Between FY 2015 and FY 2019, there was an annual high of 30 bobcats taken statewide by WS-New Mexico in 2012. Conservatively, this was rounded to 35 bobcats.

Lincoln County had the highest level of bobcats take for all counties in 2016. This take was rounded to 20 bobcats. Therefore, 20 bobcats multiplied by a factor of 3, results in 60 bobcats.

Therefore, we will utilize a WS annual maximum take of 95 bobcats.

Virginia Opossum

Follows the county estimator method.

Between FY 2012 and FY 2016, there was an annual high of 48 opossum taken statewide by WS-New Mexico in 2015. Conservatively, this was rounded to 50 opossum.

Umatilla County had the highest level of opossum take between FY 2012 and FY 2016 for all counties in 2015. This take was rounded to 45 opossum. Therefore, 45 opossum multiplied by a factor of 3, results in 135 opossum.

Therefore, we will utilize a WS annual maximum take of 185 opossum. However, since opossum are an invasive species, and are classified as a prohibited species by NMDGF, requiring opossum to be euthanized if captured as per OAR 635-056-0040, WS-New Mexico could potentially take more than the WS annual maximum take level, as required by law.

Gray Fox

Follows the county estimator method.

Between FY 2015 and FY 2019 there was an annual high of 41 gray fox taken statewide by WS-New Mexico in 2016. Conservatively, this was rounded to 45 gray fox.

Chaves County had the highest level of opossum take for all counties in 2016. This take was rounded to 20 gray fox. Therefore, 20 gray fox multiplied by a factor of 3, results in 60 gray fox.

Therefore, we will utilize a WS annual maximum take of 105 gray fox.

Spotted Skunk

Spotted skunks have had a low level of historic take between FY 2012 and FY 2016. The highest annual take in that time period was in 2012, with 8 spotted skunks taken by WS-New Mexico. While there was a high level of non-WS take (403 spotted skunks in 2013), WS-New Mexico estimates that WS take levels will be near previous levels.

Therefore, to be conservative, we will utilize a WS annual maximum take of 50 spotted skunks.

Kit Fox

WS- New Mexico had a maximum annual take of 9 kit fox in both FY 16 and FY 17. Conservatively, this was rounded to 15 kit fox.

Lincoln County had the highest level of kit fox for all counties in FY 2016 and FY 2017. This was rounded to 5 kit fox. Therefore, 5 kit fox multiplied by a factor of 3 results in 15 kit fox.

Therefore, we will utilize a WS annual maximum take of 30 kit fox.

Swift Fox

Follows the county estimator method.

Between FY15 and FY19 there was an annual high of 12 swift foxes taken statewide in FY 2019. Conservatively, this was rounded to 15 swift fox.

Chaves County had the highest level of kit fox take for all counties in FY2016. This was rounded to 10 swift fox. Therefore, 10 swift fox multiplied by a factor of 3 results in 30 swift fox.

Therefore, we will utilize a WS annual maximum take of 45 swift fox.

Hog-nosed Skunk

a. Follows the county estimator method.

b. Between FY15 and FY19 there were 2 hog-nosed skunks taken unintentionally, one of each in Lincoln County and Chaves County. Using the maximum take, this was multiplied by a factor of 3 to account for the most conservative take estimate in a given year, which is 6 hog-nosed skunks.

c. Therefore, we will utilize a WS annual maximum take of 6 hog-nosed skunks.

Appendix E. 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-New Mexico IPDM actions, but rather provides the context for the impact analysis in Section 3.8. 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 heterogeneity, 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 F. APHIS-WS Risk Assessments of PDM Methods

Wildlife Services has conducted formal Risk Assessments for the PDM methods used by WS-New Mexico to determine the risks associated with each component. A detailed review of the completed Risk Assessments is available online at:

https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/programs/nepa/ct-ws-risk_assessments.

This publication is a collection of formal risk assessments prepared by USDA-APHIS-WS and peer reviewed by non-federal professionals, with knowledge of the methods and risks associated with their use, have conducted, or will be conducting, peer reviews of the assessments. The peer reviewers were selected by the Association of Fish and Wildlife Agencies, the organization of state, provincial and territorial fish and wildlife agencies in North America, entrusted with primary stewardship over vital wildlife resources. While the analysis provided in them is extremely detailed, the entirety of those documents will not be included in this EA.

Appendix G. Joint Powers Agreement Between WS and NMDGF

COOPERATIVE SERVICE AGREEMENT (RA)(JOINT POWERS AGREEMENT)
BETWEEN STATE OF NEW MEXICO
DEPARTMENT OF GAME AND FISHAND
UNITED STATES DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT
HEALTH INSPECTION SERVICE **WILDLIFE SERVICES (WS)**

THIS AGREEMENT is entered into between the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, hereinafter referred to as WS and the NewMexico Department of Game and Fish, hereinafter referred to as the Department.

ARTICLE 1

The purpose of this Agreement is to permit WS to assist Department wildlife personnel in the reduction of damage to livestock and other property caused by wildlife and to provide for publichealth and safety as described in the attached Work Plan attached here as Exhibit A.

ARTICLE 2

APHIS WS has statutory authority under the Act of March 2, 1931 946 Stat. 1468; 7 U.S.C.426-426b) as amended, and the Act of December 22, 1987 (101 Stat. 1329-331, 7 U.S.C. 426c), for the Secretary of Agriculture to cooperate with States, individuals, public and private agencies, organizations, and institutions in the control of wild mammals and birds that are reservoirs for Zoonotic diseases, or are injurious or a nuisance to, among other things, agriculture, horticulture, forestry, animal husbandry, wildlife, and public health and
safety.

Authority also exists under Chapter 17, NMSA, 1978, annotated, for management, by thedepartment, of various species of wildlife and to control predators pursuant to 17-1-26.

ARTICLE 3

The Department and WS Agree:

a. To confer annually, prior to the beginning of the State fiscal year, to plan an animal damage control program or at other times as needed for program management. This will permit WS toassist District Department wildlife personnel in reducing conflicts caused by wild animals and to provide for public health and safety in the State of New Mexico. Based on this consultation,WS will formulate, in writing, the Annual Work and Financial Plan and present it to the Department for approval.

b. That WS will be responsible for implementing the effective Work Plan, upon approval by the Department and as may be mutually amended.

c. Each year the Department and APHIS-WS must agree to and sign the annual Work and Financial Plans, which upon execution are incorporatedinto this Agreement by reference.

d. That the project will be under the legal authority of the Department, with day-to-day supervisionand monitoring by WS and Department supervisory personnel.

e. To maintain updated District and Area personnel assignment lists and to notify the otheragency of any changes

f. That the Department will provide expertise and funding for this program, but the State portionof the program will not be subjected to federal oversight or approval under federal environmental laws

g. That APHIS-WS has advised the Department that other private sector service providers may be available to provide wildlife management services and notwithstanding these other options,the Department requests that APHIS-WS provide wildlife management services as stated under the terms of this Agreement.

ARTICLE 4

The Department Agrees:

d. To request assistance from Wildlife Services to address wildlife damage complaints only if Department personnel are unable to respond in a timely manner or as deemed necessary bythe Department.

e. To issue cougar, black bear and other necessary depredation permits, as deemed necessary bythe Department, to WS field employees who will be involved in projects statewide, and issue depredation permits for cougars for preventive control to designated WS employees within Game Management Unit 30. To send permits by E-mail or fax to WS State Office and appropriate WS District Office on the day they are issued.

f. To reimburse APHIS-WS for costs, not to exceed the annually approved amount specified in theWork and Financial Plan. If costs are projected to exceed the amount reflected in the Financial Plan, the Work and Financial Plan shall be formally revised and signed by both parties before services resulting in additional costs are performed. The Department agrees to pay all costs of service submitted via an invoice within 30 days of the date of the submitted invoice or invoices as submitted by APHIS-WS. Late payments are subject to interest, penalties, and administrative charges and costs as set forth under the Debt Collection Improvement Act of 1996. If the Department is delinquent in paying the full amount of the due service costssubmitted by APHIS-WS, and/or is delinquent in paying the due late payments, and/or is delinquent in paying the interest, penalties, and/or administrative costs on any delinquent due service costs, APHIS-WS will immediately cease to provide the respective service associated with the submitted service costs. APHIS-WS will not reinstate or provide the respective serviceuntil all due service costs, and/or due late payments, and/or due interest, penalty, and/or administrative costs are first paid in full.

g. To develop with WS the Annual Work and Financial Plans as referenced in Article 3.a. of this Agreement.

h. That upon termination of this Agreement, to reimburse the WS program for any proper outstanding billings incurred in accordance with this Agreement.

i. To pay for one WS Specialist per complaint unless the Department authorizes additionalWS personnel to assist.

j. To pay for the WS Specialist who is available, is stationed nearest to the complaint, and who is adequately trained to handle that type of complaint unless, following verbal or writtenapproval from the Department, another trained specialist from farther away is used.

k. To pay only for services requested or initiated from WS by the Department. Services requested shall include conducting activities under depredation permits, responding to WC-1 complaints, or responding to other requests from the Department to investigate suspecteddamage.

1. To provide a Tax Identification Number or Social Security Number in compliance with theDebt Collection Improvement Act of 1996.

j. As a condition of this Agreement, the Department ensures and certifies that it is not currently debarred or suspended and is free of delinquent Federal debt.

ARTICLE 5

WS Agrees:

a. That the WS designated representative will be the State Director or his or her designee whowill supervise, in consultation with the Department, all control activities pursuant to this Agreement.

b. To receive and timely respond to requests from the Department to assist in reducing wildlifeconflicts throughout the State of New Mexico, and to send a copy of 0-1 permits to the assigned WS Specialist.

c. To assist Department personnel in verifying livestock and/or other property damage by wildanimals and report such damage to the local Department representative.

d. To provide qualified personnel and other resources as necessary to implement the approved WDM activities delineated in the Work and Financial Plan referenced in 3.a ofthis document.

e. To notify the Department of all cougar, black bear or protected species taken pursuant to a depredation permit issued by the Department for that specific animal. To transfer to the Department the carcasses or parts thereof (such as head or pelt) of all cougars and black bears that are in salvageable condition. Either WS or Department personnel on site will determine on a case-by-case basis whether carcasses or parts are salvageable. To dispose of the carcasses of other protected species taken under a depredation permit as instructed by the Department.

f. To submit supporting billing information to the Department based on total hours worked, under the program work plan then in effect, as reported by individual WS field personnel.To include assigned depredation permit numbers, number of animals taken, WC-1 complaint numbers or names of Department employees requesting assistance.

g. To use the WS Specialist who is available, is stationed nearest to the complaint, and who isadequately trained to handle that type of complaint. If, in WS's judgment, another trained specialist should be used instead of the nearest on available, then WS will obtain verbal or written approval from the Department prior to using the other specialist.

h. To bill for no more than one WS specialist per complaint or request for service unless verbalor written approval to pay for more than one specialist has been given by the Department.

i. The performance of wildlife damage management actions by WS under this agreement is contingent upon a determination by WS that such actions are in compliance with the National Environmental Policy Act, Endangered Species Act, and any other applicable environmental statutes. WS will not make a final decision to conduct requested wildlife damage management actions until it has made the determination of such compliance.

J. To notify the Department if costs are projected to exceed the amounts estimated and agreed upon in the Financial Plan. WS will cease providing goods or services until a revisionto the Work and Financial Plan, as appropriate, have been agreed to and signed by both parties to this Agreement.

k. Authorized auditing representatives of the Department shall be accorded reasonable opportunity to inspect the accounts and records of WS pertaining to such claims for reimbursement to the extent permitted by Federal law

ARTICLE 6

Any equipment or supplies (immobilization equipment, traps, snares, hard-ware, etc.) purchasedunder the terms of this Agreement, exclusive of provisions of Article 15, shall be expendable in nature, need not be inventoried as they are utilized, and shall become the property of the WS program.

ARTICLE 7

WS shall not subcontract any portion of the services to be performed under this Agreement withoutthe prior written approval of the Department.

ARTICLE 8

WS shall not assign or transfer any interest in this Agreement or assign any claims for money dueor to become due under this Agreement without the prior written approval of the Department.

ARTICLE 9

WS shall maintain detailed time records which indicate the date, time, and nature of services rendered. These records shall be subject to inspection by the Department, the Department of Finance and Administration, and the State Auditor. The Department shall have the right to audit billings both before and after payment; payment under this Agreement shall not foreclose the rightof the Department to recover excessive illegal payments.

ARTICLE 10

For costs borne by WS, this agreement is contingent upon the passage of the Agriculture, Rural Development, and Related Agencies Appropriation Act for the current fiscal year from which expenditures may be legally met and shall not obligate APHIS upon failure of Congress to so appropriate. This Agreement also may be reduced or terminated if Congress provides APHIS fundsonly for a finite period under a Continuing Resolution.

ARTICLE 11

The terms of this Agreement are contingent upon sufficient appropriations and authorization being made by the Legislature of New Mexico for the performance of this Agreement. If sufficient appropriations and authorization are not made by the Legislature, this Agreement shall terminate upon written notice being given by the Department to WS. The Department's decision as to whethersufficient appropriations are available shall be accepted by WS and shall be final.

ARTICLE 12

WS functions as a contractor only under this JPA and has no authority to bind the State of NewMexico.

ARTICLE 13

Any information provided to or developed by WS in the performance of this Agreement shall be kept confidential and shall not be made available to any individual or organization by WS without the priorwritten approval of the Department or pursuant to the Federal Freedom of Information Action of 1966,as amended, and the New Mexico Inspection of Public Records Act.

ARTICLE 14

All materials developed or acquired by WS under this Agreement shall become the property of the State of New Mexico and shall be delivered to the Department no later than the termination date ofthis Agreement. Nothing produced, in whole or in part by WS under this Agreement shall be the subject of an application for copyright by or on behalf of WS.

ARTICLE 15

WS warrants that WS personnel have no interest and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of services required under this Agreement.

ARTICLE 16

This Agreement incorporates all the agreements, covenants, and understandings between the parties hereto concerning the subject matter hereof, and all such covenants, agreements and understandinghave been merged into this written Agreement. No prior agreement or understandings, verbal or otherwise, of the parties or their agents shall be valid or enforceable unless embodied in this Agreement.

ARTICLE 17

The Procurement Code, Sections 13-1-28 through 13-1-199, NMSA 1978, imposes civil and criminalpenalties for its violation. In addition, the New Mexico criminal statues impose felony penalties for illegal bribes, gratuities, and kickbacks.

ARTICLE 18

Nothing in this Agreement shall prevent any other State or organization or individual from enteringinto separate Agreements with WS for the purpose of controlling damaging animals.

ARTICLE 19

Pursuant to Section 22, Title 41, United States Code, no member of or delegate to Congress shall beadmitted to any share or part of this agreement or to any benefit to arise therefrom.

ARTICLE 20

APHIS assumes no liability for any actions or activities conducted under this agreement except to theextent the recourse or remedies are provided by Congress under the Federal tort Claims Act (28 USC1346(b), 2401(b), 2671-2680).

Article 21

Any tort liability or the Department of Game and Fish in connection with this agreement is subject to the immunities and limitations of The New Mexico Tort Claims Act (41-4-1 NMSA 1978) and the Department of Game and Fish assumes no liability for any actions or activities conducted under this agreement beyond those permitted under the said Act.

ARTICLE 22

All wildlife damage management activities will be conducted in accordance with applicable Federal,State, and local laws and regulations.

This agreement is not a procurement contract (31 U.S.C. 6303), nor is it considered a grant (31 U.S.C. 6304). In this agreement, APHIS provides goods or services on a cost recovery basis tononfederal recipients.

ARTICLE 23

Department of Game and Fish obligation is subject to approval in writing by the Department of Finance and Administration. This agreement shall become effective on July 1, 2017 and continue through June 30, 2022. This Cooperative Service Agreement may be amended at any time by mutualagreement of the parties in writing. It may be terminated by either party upon written notice delivered to the other party at least 60 days prior to the intended date of termination. By such termination, neither party may nullify obligations already incurred for performance or failure to perform prior to the date of termination. In the event the Department does not for any reason reimburse WS the necessary funds, WS is relieved of the obligation to continue any operations under this Agreement.

ARTICLE 24

Once signed, this agreement shall constitute any permit or license required from the state to effectuate the terms of this agreement. Under this agreement, WS field employees are not requiredto carry a permit per NMAC 19.31.10.

ARTICLE 25

This agreement replaces and supersedes the previous agreement between USDA/APHIS/WildlifeServices and New Mexico Department of Game and Fish.

Agreement/JPA No. 17-73-35-228 6 (RA)
WBS No. AP.RA.RX35.73.0974

In witness thereof the parties hereto have executed this Cooperative Service Agreement as of thedate of execution by the DFA, below.

2-12-17
DATE

State Director, New Mexico United States Department Animal and Plant Health Inspection Service Wildlife Services

Jason Suckow
Director, Western Region
United States Department of Agriculture Animal and Plant Health Inspection Service Wildlife Services

Alexandra Sandoval Director
New Mexico Department of Game and Fish